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Engineering News-Record

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Building the Highest Dam in Europe
—By Willis Ranney

An Examination of the Slenderness Ratio and Strength of Concrete Columns
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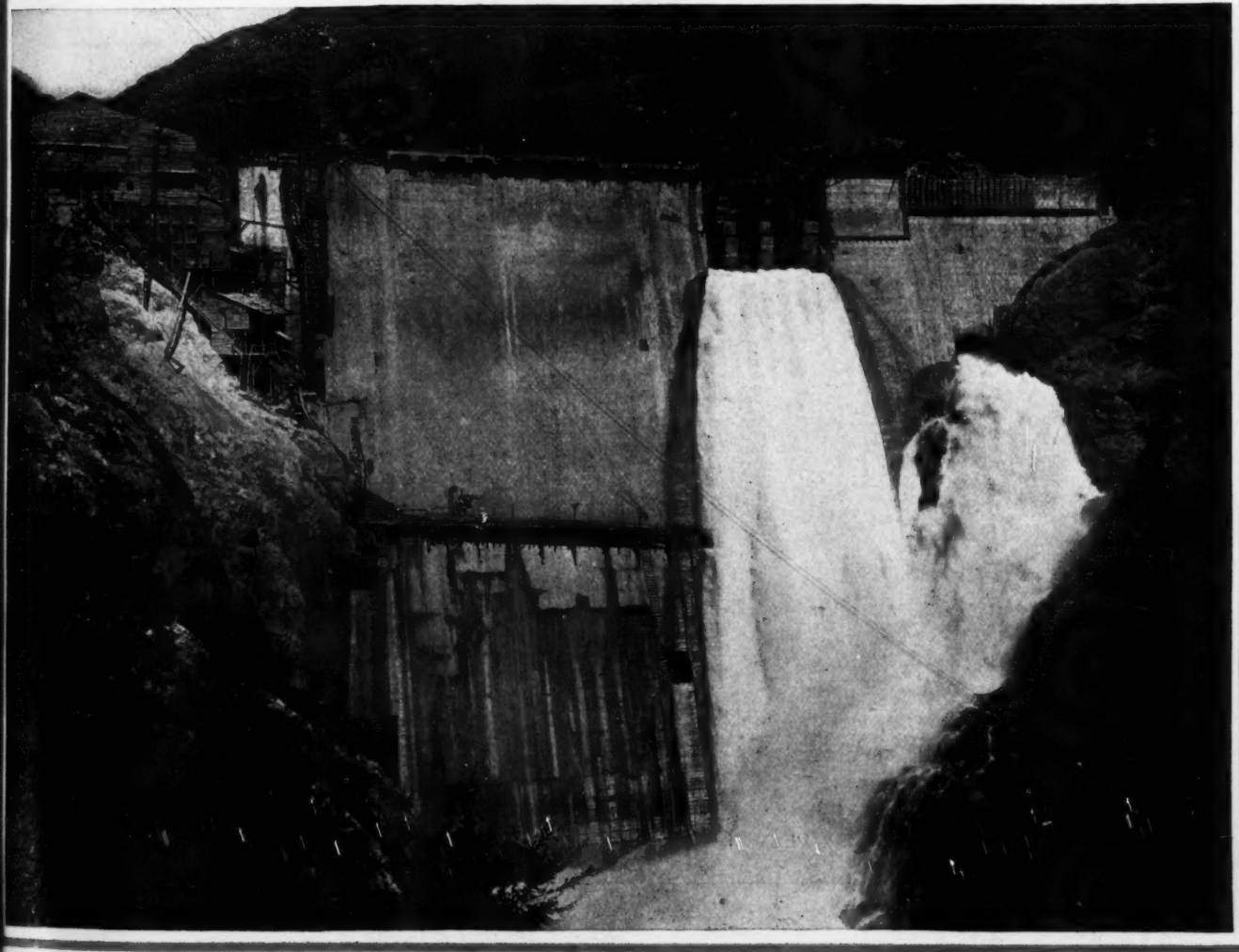
Engineering Literature—Reviews of New Technical Books

The Highest Dam in Europe—The Camarasa Dam near Barcelona, Spain—333 ft. above Bedrock—270 ft. Head Developed for Power



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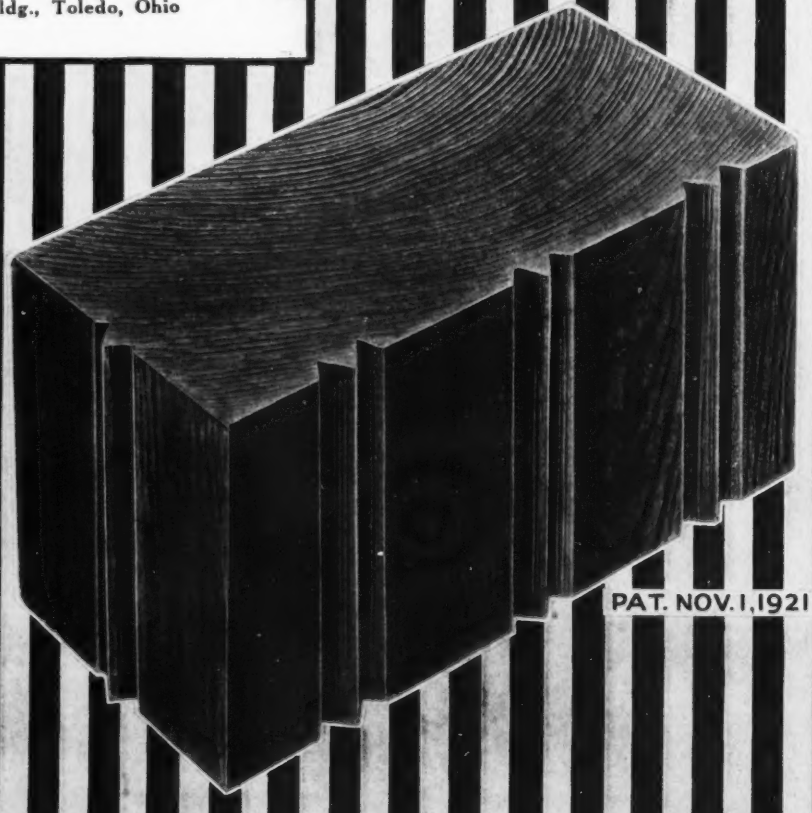


A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 89 — NEW YORK, AUGUST 17, 1922 — Number 7

King for a Day

JOHN MITCHELL at his zenith never reached the heights that John L. Lewis occupies today. He is King—undisputed. He has forced a settlement of the coal strike practically on his own terms: no wage reductions and no arbitration. He has done a bit of "tail twisting" and in doing so has not merely triumphed over the operators but over the public. At a time when all wage scales are coming down, even those of the railroad workers, he successfully holds his wages level. The public wanted and expected cheaper coal. The operators tried to get it for them. But Lewis said, No, and No it is. Thus 750,000 miners have told the 24,000,000 farmers and wage earners in the United States that the miners are superior to the present economic law which has affected these other 24,000,000. Indeed Lewis is King, but is it merely King for a day? Have not the other 24,000,000 a way of speaking and acting?

Almost the Record Dam

WE AMERICANS have become so used to having the largest of every type of structure on this side the ocean that the close approach to a record of the Camarasa dam comes as a surprise. It happens that this Spanish dam falls some twenty feet short of the highest dam in the world—which honor continues to be held by our own Arrowrock—but for head of water Camarasa is fifty or more feet higher than any other dam ever built. Record size is ephemeral, but while it lasts it has its claims to notice. It is not merely for size, however, that this structure is worth describing. Mr. Ranney makes clear, in his interesting article, that the construction methods in this high place in the Pyrenees, under war conditions and far removed from what we are apt to consider the center of modern construction ideas, were as up-to-date as though the dam were being built in these days of peace in reach of an American railroad. Not only as a record of dam construction is the article useful, then; it has its value in the wider view it may give to American engineers of the practice of their profession in a country that has not been thought of as a leader in engineering.

Conserving a National Asset

THE news columns of this issue contain a brief note concerning the work of the engineers at the July training camp for reserve officers held at Camp Dix, N. J. The pity is that so few of the officers have been able to attend these camps. The program of the War Department contemplated the calling of some 2,000 officers in each corps area for a minimum of two weeks' training. Thanks to the niggardly policy of Congress in matters of national defense the allotment was cut to 500. The military policy of the United States rests upon the existence of an organized reserve ready to back up at short notice the tiny regular army and the widely-dispersed National Guard. The framework of that reserve is the body of experienced and trained officers who were returned to civil life after the war and who require but a minimum of contact with army activities to keep their knowledge fresh and their interest alive. To afford them this contact involves but a trifling investment of the national resources that will surely return large dividends in human life and treasure. May Congress next year see this more clearly and give greater weight to the sage and statesmanlike counsel of our foremost soldier.

The Next Best Thing

PENNSYLVANIA will not be fortunate enough to have a practicing engineer for governor next year but she will be sure to get a man with an appreciation of engineering methods and thought. Gifford Pinchot, the Republican nominee, is an Affiliate of the American Society of Civil Engineers and was, as those members of long standing will remember, an energetic speaker at a famous discussion on the effect of forests on rainfall and runoff some thirteen years ago. The Democratic nominee, John A. McSparren, it now appears was educated as a civil engineer, though in recent years he has farmed it so successfully as to become Master of the State Grange. For a state with so many engineering problems Pennsylvania is fortunate in her gubernatorial prospects.

A Pioneer in Reinforced Concrete

THE early history of reinforced concrete revolves around a few men who recognized the possibilities and difficulties of the new material and set to work as specialists to study its peculiarities. In Europe, Coignet, Considère and Hennebique, the great French trio, are remembered with Melan and Wayss and Freytag in the German-speaking countries; all of them worked first some thirty years ago. It was characteristic of these Europeans that each developed his so-called system, a special type of design which he not only prepared but built. There was no independent engineer making a design to be built by a contractor, as is common in other types of construction, but the idea was fostered that there was something mystical and special in reinforced concrete which was not revealed to the common run of engineer. It was natural that this idea should migrate, along with the development of reinforced concrete, to this country, but over here it has not persisted. The designer-builder survives to some small degree, but mainly in the form of the designer-steel man. Of this latter type was A. L. Johnson who died last month. In his later years Mr. Johnson was known best in his capacity as head of a great steel reinforcement company and his earlier history forgotten. Those early days should be remembered by all interested in concrete work today. He was one of group, among whom were Ransome, Kahn and Thacher, who in the first years of this century carried forward the new theories then just being brought to American engineers. That each of

these men should form commercial affiliations was only following the European tradition. It in nowise detracts from the scientific value of their services to the study of reinforced concrete. Mr. Johnson was not an old man but he was already an ancient in a well-established art.

Direct Oxidation Again

THOSE who have been following the adventures of the direct-oxidation or lime-electrolytic method of sewage treatment will do well to consider Mr. Lanphear's data and opinions based on the Easton tests and on his own studies at Worcester, Mass., as given by him elsewhere in this issue. These data and conclusions confirm the consensus of opinion among sanitary engineers that whatever of importance the direct-oxidation process effects can be done equally well and at less capital and operating expense by the use of a heavy dosage of lime in a chemical precipitation plant. The fact is, as Mr. Lanphear points out, that a heavy dose of lime was used in the Easton tests and that too on a sewage that had been passed through bar screens, a grit chamber and fine screens. He might also have mentioned the mechanical agitation of the sewage at Easton by the hundreds of paddles—used, the promoters stated, to keep the electrodes clean but which possibly may have had the same beneficial action as is claimed by those who would substitute paddles for compressed air to agitate sewage in the activated-sludge process. This confirmatory evidence from the chemist and chief operator of what is now the oldest and next to the largest chemical precipitation plant in the country puts a new burden of proof on any one proposing the use of the direct-oxidation process.

Thompson and Tires

TO most engineers who are building and maintaining roads today the fact that June 29 marked the hundredth anniversary of the birth at Stonehaven, Scotland, of Robert W. Thompson carries no particular significance. Yet this man revolutionized highway transport and his influence is manifest on a world-wide scale in practically every detail of highway design and construction. It was Thompson who was the original inventor of the pneumatic tire and the pioneer in the use of solid-rubber tires for road traction. He was a young man, only 23, according to the London *Times*, when he patented the device which he described as "a hollow belt composed of some air and water-tight materials such as caoutchouc or gutta percha and inflating it with air whereby the wheels will, in every part of their revolution, present a cushion of air to the ground or rail or track on which they run." The outer covering or facing was specified as a "series of circular segments of leather . . . protected by flat-headed metal rivets secured by small washers." Thompson was ahead of his time and abandoned the exploitation of the pneumatic tire to engage in other inventions. Later, however, when the steam tractor was being developed for road transport he took out new patents for heavy solid rubber tires in 1867-73. A road steamer, thus equipped, demonstrated exceptional hauling power and a number of these tractors were ordered by the Indian Government, the tires on these machines being 6 ft. in diameter, 15 in. wide and 5 in. thick. From these beginnings in tire equipment for motor vehicles steady progress has been made until today vehicular traffic on the roads is rendering a service in moving people and commodities on a scale undreamed of a generation ago. The trend of design in tire equipment is toward the protection of both road and vehicle from the impact and the general wear and tear incident to heavy haulage. Improvements have been made in solid tires, with the dual tire now common to distribute the weight of heavy trucks. Without such pioneer work as Thompson did, road transport could never have assumed the importance in our economic life that it now occupies.

Arbitrating Contract Clauses

CONTRACTORS have frequently been the victim or object of strikes; there is a certain novelty in their using the strike as a weapon. Apparently this was the only way the contractors in and around Louisville could force the sewer commission of that city to a reform of its contract and specification provisions on new sewer work. As is noted on another page, the strike was effective in a majority of the points at issue for the commission agreed to reword most of the objectionable clauses. The new wording seems so clear and just that the wonder is why it required so radical a move as a contractors' strike to convince the commission of the necessity for reforms.

The main point of contention, however, was only partly settled. The contractors objected to the engineer being made omnipotent in matters of contract and specification interpretation and asked for arbitration provisions. The commission gave way only to the extent of permitting an appeal to itself in disputes affecting compensation. Thus in the tripartite owner, engineer and contractor relation the engineer is shifted from his traditional position as unprejudiced umpire to be a partisan disputant, and the owner becomes the judge in a case involving his own pocketbook.

It can hardly be said that this is a satisfactory solution of this vexing question of engineering authority and possible arbitration. For years the construction contract has been based on the theory that the engineer, obviously the agent of the owner, is at the same time an unbiased umpire between the owner and the contractor in a contract which the engineer has written. This is an anomaly to which contractors have justly objected and which they have tried to correct by insistence on an arbitration clause which would submit all disputes to an outside party.

Two things have acted against the acceptance of such a clause; the difficulty in limiting the issues to be arbitrated and the natural reluctance of the engineer to prejudice his authority.

These two are rather more closely interlocked than at first sight appears. The engineer is the responsible party in any piece of construction. He designs it and he supervises its erection. He is entitled, therefore, to have it put up the way he wants, provided always that in his specifications he can foresee that way sufficiently to cover the general details of how the work is to be done. Language being at best an imperfect expression of thought it is impossible to provide in a specification for all contingencies. The engineer, therefore, must be permitted some leeway in his interpretation of his specifications; he cannot be subjected to the danger of being continually harassed by reference to an arbitrator or of

having his control of the work lessened by threats of such reference.

There should be some middle ground, however, on which all parties can meet. In fact such a compromise has been reached in many contracts. In them the engineer's decision is supreme at the time; the contractor must follow it but he is allowed appeal for compensation to a disinterested arbitrator, sometimes named in the contract itself. The engineer must remain the judge of such things as quality of material and execution, in which the exercise of his technical skill is required. But he has not the omnipotent powers of specification interpretation conferred upon him by such clauses as the one to which the Kentucky contractors objected.

Arbitration clauses, properly written, are desirable additions to a construction contract. Not only will they tend to a fairer relation between contractor and owner but they should lead to better and more precise specifications, for the possibility of outside interpretation will be ever in mind in the writing of the specification. But the contractor who works under such a clause, if he can persuade the owner to insert it, will only delay the more general adoption of arbitration if he uses it merely as a club to hold over the head of the engineer or as a means of delaying the execution of the contract.

A Responsibility of Leadership

IN AN address to the National Lumber Manufacturers' Association, W. A. Durgin, chief of the division of simplified practice of the Department of Commerce, has declared that he deplores "the insidious assumption that the function of government is to originate rather than to discover the best thought, and to impose, rather than to help make effective the best practices."

The elementary principle here laid down for government is thoroughly sound and applies with equal force to successful and fruitful management in almost any field. The efficient executive is not the man who thinks up all the bright ideas and uses his subordinates as mere hands and feet to do his bidding. This is a popular conception, but it is mistaken. It must be remembered that in addition to the material product of industry, the tons or the gallons or the ton-miles, there is a by-product of scarcely less value. This is the supply of trained manhood that is brought up to think and to dare and to do in carrying forward the work of tomorrow. Successful management must produce men as well as materials or service, and the great executive is the man who rises to this responsibility.

The able manager, therefore, is known by the ability of the men with whom he surrounds himself. If he has difficulty in procuring able men to start with, he gets the best he can and sets out to make able men of them. He encourages them to original thinking, he teaches them to appraise fairly their own ideas and to carry them through to practical conclusions. He inspires them with a consciousness of their power, stirs their creative instincts, and instills in them a sense of participation which begets the complementary sense of responsibility. All these are functions of management, and in proportion as men perform these functions they are truly leaders rather than mere "bosses" or taskmasters.

In this day, when engineers are coming more and more to be called into executive positions, we all can afford to ponder this sometimes forgotten aspect of industrial leadership; for our worth as executives will surely be measured by the merit of those that follow us.

Maintenance the First Task of Highway Development

A STATE becomes potentially "active" in road improvement as soon as its people have voted a large bond issue. The public begins at once to "expect to see something done." The more parsimonious the state has previously been in all matters pertaining to good roads, the more exacting will be the demand for fast spending once there is money in pocket.

Astute vendors of commercial types of roads take quick advantage of the public's desire for "results" and often create a buyer on the argument of fast delivery. If the state has a highway commissioner firm enough not to meet the dilemma by buying, he lands on the other horn of newspaper and crossroads-store criticism because of indolence. Indeed the situation is not easy.

A highway department organized for moderate hand-to-mouth expenditure is confronted with a huge problem when fifty or sixty million dollars are chucked into its lap, with orders to hurry up and spend it for improved roads. It is virtually compelled to temporize. It must take time to plan and inaugurate construction. Additional time is required to perform the work. Almost two years must elapse ordinarily before any considerable mileage of newly built road is completed and it is then only an inconsiderable portion of the total state road mileage. Meanwhile all the people are paying and all not immediately served are getting disgruntled or apathetic, if they are not developing a positively reactionary sentiment toward highway development.

All this leads to the question whether the prevailing practice, when a state undertakes wholesale expenditure, of seeking big mileages of construction and postponing maintenance problems, is not an engineering and business error.

Should not maintenance of state system be the primary task?

Even if the old roads of the system are dirt roads and will ultimately all be paved is it not a tactical advantage to put them and keep them in the best condition possible for dirt roads? It manifestly would help to moderate criticism. Moreover, with modern practices of progressive road improvement much of the maintenance work, if it is wisely directed, can be capitalized as permanent grading and widening.

If a rule were to be laid down for state highway departments, with a big bond issue for the first time and a jealous public watching for a demonstration that its generosity had not been amiss, the suggestion would be that this be the rule:

As soon as the main road system is selected begin intensive patrol maintenance on the basis of progressive construction.

Let construction go until it can be adequately planned and carried through. Maintenance is the first task because it immediately reaches every man along every mile of the state system. Let it be patrol maintenance, not merely because this is the most approved practice but so that every man along every mile can see every day the work being done.

The work in North Carolina, described in this journal July 27, is a striking example of the success of this policy.

Building the Highest Dam in Europe

Features of the Camarasa Hydro-Electric Development in Cataluna, Spain—Built at High Speed Under War Conditions—Dam 333 Ft. High With Gravity Section of Sand-Cement Concrete

By Willis Ranney
Consulting Engineer, San Antonio, Tex.; Formerly Construction Superintendent Ebro Irrigation & Power Co., Ltd., Camarasa Project, Spain

EUROPE'S highest dam, built in the face of manifold handicaps chief of which was the World War, is located on the swift flowing and snow fed Rio Noguera Pallaresa in the Pyrenees Mountains of northern Spain. With a height above bedrock of 333 ft., the dam creates a most picturesque reservoir and develops a head that generates 88,000 hp. at the Camarasa Project which it serves. The remoteness of the site, has Barcelona as its capital. Three existing water-power plants, Pobla and Tremp on the Rio Noguera Pallaresa and Seros on the Rio Segre, were turning out 96,000 hp., distributed by 110,000-volt transmission lines, which was far short of the ever-increasing demand. The splendid power concession at Camarasa on the Noguera Pallaresa, owned by the same group of capitalists, offered through its development an additional 88,000 hp. The emergency was sufficient to permit arrangements with the Allied Governments which assured the vital equipment and supplies. The building of the Camarasa Project was started during the summer of 1917 and completed in three years by overcoming great difficulties in securing materials and equipment, opposition from hostile interests and the very acute labor shortage and unrest during and after the war.

LOOKING DOWN THE RIVER NOGUERA PALLARESA TOWARD THE RIVER SEROS
Dam site in middle foreground laid dry by cutoff at up-river reservoir. Concrete plant under construction on right bank

the unusual conditions regarding materials and labor and the general method of attack of such a piece of construction under European conditions make the project one which may interest American engineers.

The great industrial activity incident to the war brought about in Spain a tremendous need for water-power, particularly as the war had shut off the supply of steam coal previously brought in by ship to Barcelona, the largest city and second port of Spain. British-Canadian interests already owned the power and public service companies which supplied the bulk of available power to the industrial cities and towns of Cataluna, which state includes northeastern Spain and

The construction was handled by the Ebro Irrigation & Power Company, Ltd. (Riegos y Fuerza del Ebro, S. A.), with main office in Barcelona and purchasing agencies in London and New York. The bulk of the re-

quired equipment and supplies was imported from the United States, England and Switzerland. Electrical installation is American and the hydraulic turbines Swiss.

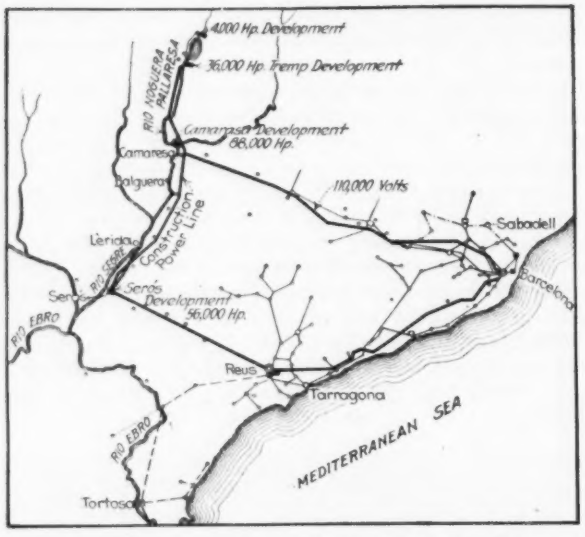
Location—Two rivers, the Noguera Pallaresa and the Segre, in working their way from their snow-fed sources in the high Pyrenees to the plateau country south of the mountains, have cut a series of deep gorges through faulted sections of the massive cretacious rocks. Their confluence or junction occurs about two miles north of the old Spanish town of Camarasa, from which the project takes its name, where the former flows into the latter. A half-mile below the confluence at Dos Rios the Segre debouches into the plateau region leaving the deep gorge and flowing south and southeastward past the towns of Camarasa and Balaguer and the city of Lerida to its junction with the Rio Ebro, which flows into the Mediterranean Sea and is the largest river of Spain. At Lerida, the waters of the Segre are diverted by a dam into a power-canal, 15 miles long, at the lower end of which is the company's Seros power house (56,000 hp.). After passing the turbines the water is returned to the Segre through a tailrace. The Pobla installation, 28 miles above Camarasa on the Pallaresa, develops 4,000 hp. by diversion and that at Tremp, eight miles below Pobla, develops 36,000 hp. by means of a high dam and storage reservoir. With the present four waterpower plants, the waters of the Rio Noguera Pallaresa are harnessed four times in a distance of 64 miles.

It was not feasible to build the Camarasa dam below Dos Rios, thus impounding the waters of both rivers, because the city of Artesa with its rich irrigated valley on the Segre eleven miles upstream would have been submerged by the reservoir. Therefore a dam site was selected on the Noguera Pallaresa, 1,000 ft. from the confluence, at a very narrow part of the deep gorge. The steep topography made it necessary to place the spillway adjacent to the south abutment of the dam and the headworks controlling the flow from reservoir to power house on the opposite side at the north abutment. From here a location was made for a canal and tunnel to take the water to a forebay (really a continuation of tunnel) which was directly above a feasible site for the power house against the north wall of the gorge just above the confluence. The power-drop was secured by five penstocks in tunnels leading from the forebay to turbine-floor.

LOOKING UPSTREAM AT THE COMPLETED CAMARASA DAM

Dam is 333 ft. above lowest part of foundation. Note outlet of large tunnels above power house to be connected thereto by penstocks

Preliminary Work—Foundation rock under test showed excellent structure and all suspicious zones which could be located were sealed by pressure-grouting or concrete prior to filling the reservoir. The rough and precipitous character of the terrain combined with distance from railway and lack of roads and bridges made the layout for transportation, camps and construction plant quite a problem and required a great deal of costly preliminary work. Ten miles south of Dos Rios at the town of Balaguer, the terminus of a narrow-gage branch of the Norte Railway, the company had in storage construction equipment, left from the previously



POWER HOUSES AND TRANSMISSION LINES OF THE EBRO CO. IN SPAIN

The Camarasa Dam—333 ft. high, the highest in Europe, is on the Noguera Pallaresa River about 80 miles northeast of Barcelona.

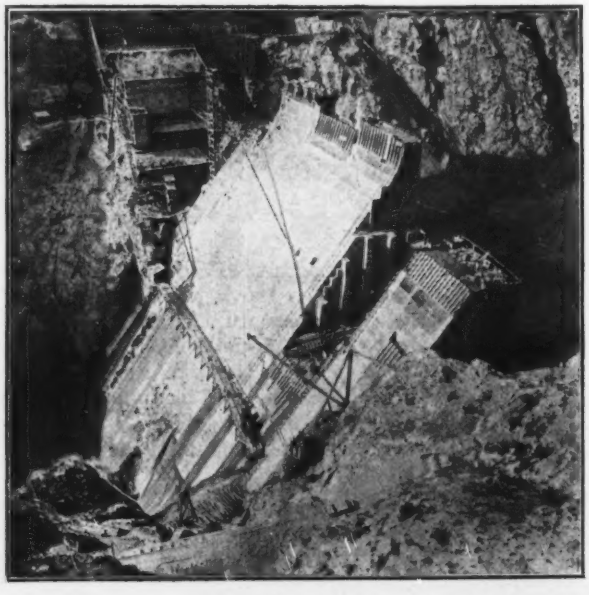
completed projects, which possessed unusual value under war conditions. In addition, there were transport and accounting offices, storehouses and shops. It was therefore necessary to rebuild the very poor road from Balaguer to Camarasa and construct a new road beyond, extending up the gorge to Dos Rios. After passing the main unloading station, under the east terminal of the cableway built across the Segre just below the confluence, this road terminated at the general shops and sawmill. Its completion, together with proper maintenance and the excellent facilities at Balaguer, resulted in the prompt handling and transportation of supplies, materials and equipment by steam-tractor trains, wagons and trucks. The heavy loads were handled by tractor while the biggest single item, cement clinker, was hauled by local teamsters on a per ton contract basis.

Camps—The Spanish workmen with their families totaled some ten thousand persons and the historic town of Camarasa, surmounted by its ruined castle, did not afford sufficient accommodations. In addition, there were no suitable quarters for the members of the construction-engineering staff, foremen and specially skilled men, some of whom had their families with them. To supply the need, four camps completely equipped were quickly built along the road between Camarasa and Dos Rios. All were supplied with pure water, had sewer-systems and incinerators and the general health was safeguarded in every possible way.

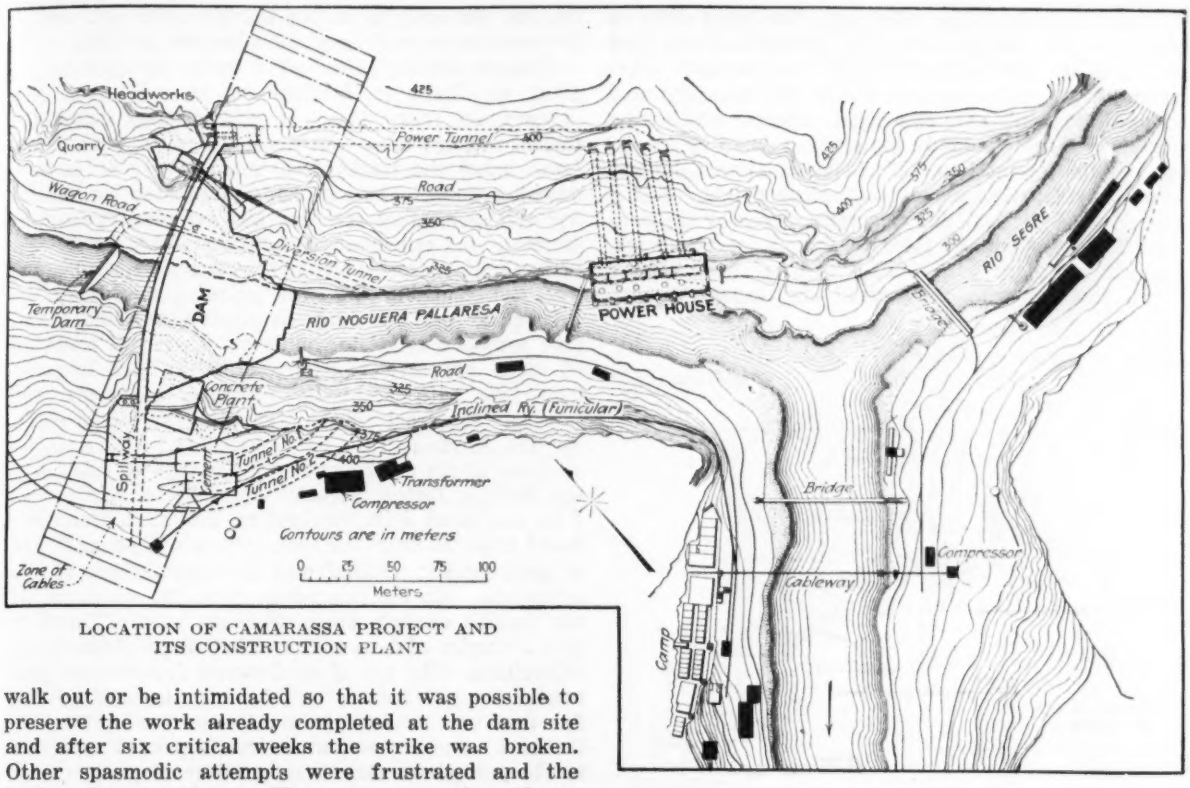
Power for the construction work was obtained by substation connection at the second camp with existing 110,000-volt transmission line from Tremp to Barcelona. The voltage was reduced to 25,000 and taken to Dos Rios over a pole-line built up the gorge where it was further reduced to 440 volts for motors and 220 volts for lighting by two substations on the job, one at river and the other at upper cableway levels.

Organization and Labor—All foreign work, where modern methods are used, requires special organization. The selection of men, composing the construction-engineering staff and the nucleus of foremen and special workmen is all-important. Men with excellent records in their native country back of them are often unable to adapt themselves to changed conditions, handle the available labor or stay for the several years' time required for a big construction job. It takes more than usual enthusiasm, determination and patience along with ability to render the service required. Frequent changes with the consequent shipping in of new men are demoralizing. Good quarters and food, care of health and a reasonable amount of recreation for the men who are "strangers in a strange land" make a splendid investment for any company engaging in work away from home. The stores and transport departments require careful handling. Needs must be anticipated and proper stocks of supplies and spares provided. Deliveries of construction, hydraulic and electrical equipment must be on time and the steady progress towards completion must not be hindered by failure to receive this or by the shortage of that essential thing. The training of native workmen for skilled jobs is worth while and at Camarasa, during the war, was particularly necessary as a large percentage of the men from the United States, England and France, employed on previous work, were not available. It was surprising to see what could be done by carefully selecting and training unskilled Spanish workmen. They quickly learned to operate cableways, derricks, locomotives, etc., skillfully and kept their machinery in running order. Most of the civil engineers were Spanish and did excellent work.

Labor conditions were very unsettled during the entire period of the Camarasa construction. There was always a shortage of men in spite of labor agencies maintained throughout Spain. Agitators, representing the "Sindicato Obrero" which is a radical labor organization with Bolshevik tendencies, and mysterious foreign agents tried every means to incite the company's workmen to strikes, violence and sabotage. This was counteracted by constant vigilance on the part of the company, fair treatment and the presence of civil-guards for whom all wrongdoers in Spain have a wholesome respect. Only one serious strike occurred, but enough loyal and fearless Spanish workmen refused to



CREST BEING PLACED ON HIGHEST POINT OF DAM



LOCATION OF CAMARASSA PROJECT AND ITS CONSTRUCTION PLANT

walk out or be intimidated so that it was possible to preserve the work already completed at the dam site and after six critical weeks the strike was broken. Other spasmodic attempts were frustrated and the leaders forced to leave. There were several accidents, breakdowns and fires which could be classed as sabotage but, all in all, the company was very fortunate.

Construction Plant—The general layout of the construction plant is shown in the plan. The placing of the main units on the south cliff just downstream from the dam was dictated by the location of the height required for gravity handling of materials and the location of the funicular. This incline railway, completed early, was operated by an electric-hoist with 1-in. cable and, starting at the lower level under Segre cableway, climbed up the south side of the Palleresa gorge past the successive levels occupied by crusher-mixer plant. spillway, main quarries and cement plant to the upper cableways, a vertical distance of 380 ft. Gravity was utilized from the delivery of materials to the cement plant at the top to the placing of concrete in the portion of dam below the mixers.

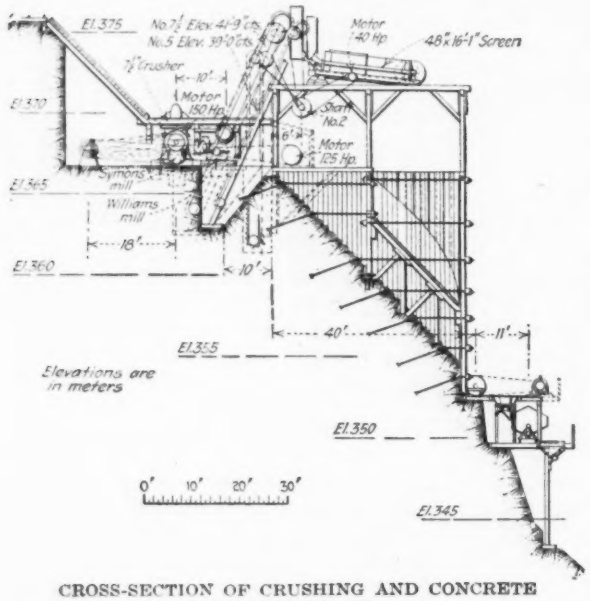
The general shops, which are very complete, were built as soon as the road was finished. Lumber was produced by two sawmills, built along the Segre, which were supplied with logs brought down the rivers in rafts. With the exception of derrick, cableway and heavy plant timbers, which were American longleaf pine, imported at great expense as the Spanish pine was brittle and small sized, all lumber and timbers used for the construction were sawn from native pine logs. A steel bridge was built across the Segre just above the confluence giving access to the power-house site. Difficulty in obtaining structural steel compelled the use of second-hand trusses and crane-girders from the company's storage yards in Barcelona. A system of narrow-gage railway tracks, above flood level, connected the Segre cableway unloading station with the shops and power house and the opposite terminal of this cableway with the funicular and the dam.

Master Cableway—The completion of the funicular was followed by the erection of the master cableway at the dam site. It occupied the topmost position, 500 ft. above the deepest dam foundation, and was put up by means of a temporary 1½-in. cable stretched across the gorge. The 2½-in. main cable had a span of 1,060 ft. between the head and tail towers, which were traveling type, and a ten-ton load was easily handled. The low height of the counterweighted head tower of 54 ft. made possible by an arrangement of guide sheaves, is noteworthy. Six thousand feet of ¾-in. wire rope were required for button, endless and fall lines and the engines were operated by compressed air. With this cableway and the funicular in operation, the handling to place and assembling of the rest of the plant was greatly facilitated. Two other cableways were put up at funicular-head level on the platforms directly below the upper one with spans of 970 ft. The main plant and dam were within the traveling zone of the cableways, which was 225 ft. up and down stream, and they were kept very busy day and night.

Next below the cableways was the cement plant consisting of raw material bins for portland cement clinker and gypsum, delivered by funicular, and sandstone, brought over by cableway at night, a 5 x 50-ft. revolving direct heat drier with stack, two compeb-mills 5 x 22-ft. with synchronous motors, storage-bins of 4,000 tons capacity for finished product, miscellaneous elevators, conveyors, etc., and a completely equipped laboratory for chemical and physical tests.

Below the cement plant were the main quarries, which included the open-cut spillway excavation and extended upstream. Here much preliminary work was necessary as track-benches had to be cut along the cliffs which were sheer in many places. The output, on account of

seams and pockets filled with clay, was very dirty so that rock for the crushers was hand-picked and then loaded either into skips or directly into the cars. Derricks or locomotive cranes picked up the skips and dumped them into cars of 4-cu.yd. capacity which were hauled in six-car trains to the crusher dump by saddle-tank 18-ton locomotives. Waste material was dumped into the reservoir area at convenient points. Steam shovels were not available as several owned by the company had been sent by them to France for war work. Drilling was done with 3-in. tripod and ¾-in. rotator drills, supplied with compressed air through a pipe



CROSS-SECTION OF CRUSHING AND CONCRETE MIXING PLANT

system from the compressor stations. Only Spanish explosives, made near Bilboa, were obtainable for the blasting and general excavation. The dynamite was none too good and the blasting powder very uncertain and very expensive, the price being double that of imported high-grade explosives. Complete shop equipment, for machine sharpening of drill steel and general repairs of drills and cars, was provided.

On the opposite or north side, two other quarries were opened up. One, just above the cableway levels where sandstone was found overlying the dolomite, provided rock for the sand-cement. Its output was loaded in dump cars of cubic-yard capacity, pushed down a gravity grade to a platform in front of the cableways, dumped into a bin from which buckets were filled and then taken by one of the cableways across the gorge to the bin at the drier. The other, about 60 ft. above river level, supplied large rocks or plums which were embedded in the concrete of the dam. Skips, filled with one or more plums, were loaded on flat-cars by locomotive crane or derrick and the trains were hauled by locomotimes to switch tracks at the dam, located within reach of derrick and cableways which did the placing and returned the empty skips. The biggest plums weighed ten tons and the quarry was operated until flooded by the rising reservoir early in 1920. After that plums were secured from spillway excavation. The output of the quarries was augmented by rock excavation from the dam site and the various tunnels which was sent to the crushers or used as plums whenever possible.

Crushing-Mixing Plant—The main crushing-mixing plant was built on benches cut in solid rock just downstream from dam. It was directly below the cement storage bins with crusher-feed at proper distance below the tracks from main quarry to allow a dumping apron. There is shown a cross-section indicating arrangement of crushing and grinding machinery, elevators and conveyors, screen-house, bins for storage of crushed rock and sand and the concrete mixers below. The rock crushing and sand grinding machinery are grouped to form two duplicate plants thus giving insurance against a complete shutdown. Each unit consisted of large gyratory and disc crushers and hammer-pulverizer with necessary elevators, conveyors and screens. The crushing plant, running two 8-hour shifts per day, handled all the rock gotten out by the quarries in three shifts as the constant shortage of labor was the limiting factor. Crushed rock, 4½ in. retained on ⅜ in. and sand ⅜ in. retained on 100-mesh, were produced from the dolomitic rock. There was no local sand of good quality, which forced the manufacture of fine aggregate. As the screenings from the crushers did not furnish enough, these machines were adjusted to give a surplus of 1-in. rock which was put through the pulverizers. The use of sand-cement for concrete prohibited the presence of rock-flour in the sand so this fine dust was removed before the sand was stored in the bins. Fan-blowers, where suctions were connected to the pulverizers and to screened openings in chutes from revolving-screens to bins, were used successfully. The grading of crushed rock and sand was maintained by adjusting the machines if the mechanical analyses, taken several times daily, showed any decided variation.

The mixing machinery consisted of a battery of five 1-cu.yd. batch mixers located with charging-floor directly below the rock and sand bins. Concrete was dumped into hoppers for distribution to gravity chutes, loading stations for bottom-dump buckets and tower-hoists which supplied gravity chutes for high levels.

In addition to the main plant at the damsite, there was a small crushing plant consisting of jaw-crusher, elevator and screen at the forebay above the power house which crushed rock taken from adjacent tunnel excavation. Adjoining this plant were two mixing plants, each with a 1-cu.yd. batch mixer, one of which supplied concrete for tunnel lining and the other, located on the cliff above the power house, fed concrete to that work by gravity chute. The portland and sand-cement and fine aggregate for these plants were brought over from the main plant by cableway to a track level along which the materials were handled in small cars to destination.

Sand-Cement and Concrete—When the company sold the complete, 350-ton capacity, portland cement plant, used for the Pobla and Tremp Projects, to a Spanish company which installed it near Barcelona, a contract was made covering the portland cement and clinker required for the Camarasa Project. A series of careful laboratory tests proved that a satisfactory sand-cement could be made by grinding clinker and required gypsum with either dolomite or sandstone, secured at Camarasa, so that 90 per cent passed a 200-mesh sieve. While jar-mill tests at laboratory indicated that dolomite could be used, it was found by actual operating tests with compeb-mills that the sandstone was at least a 40 per

cent better grinding medium than the dolomite. It was obtainable from a high level quarry and was therefore used in a mixture, by weight, of 54.3 per cent clinker, 44.4 per cent sandstone and 1.3 per cent gypsum. The maximum output per mill-hour was 4.25 metric tons at proper fineness but the average was 3.75 tons. The average loading for each mill was 14 tons of "concavex" 3-in. slugs and 4 tons of 2-in. to 5-in. balls. With sandstone having 89 per cent to 92 per cent SiO_2, the analysis of the sand-cement was

SiO_2	54.30
AlO_3	54.30
FeO_3	2.00
CaO	33.20
MgO	0.89
SO_3	1.38
Loss on ignition	2.43
	100%

The Public Works Department at Madrid decided on a compressive strength for concrete 90 days old which corresponded to 2,127 lb. per square inch. This was fixed by royal decree and it took not less than 461 lb. of sand-cement per cubic yard of concrete to secure the strength required. The mix used for the dam was proportioned to give a dense concrete of proper strength.

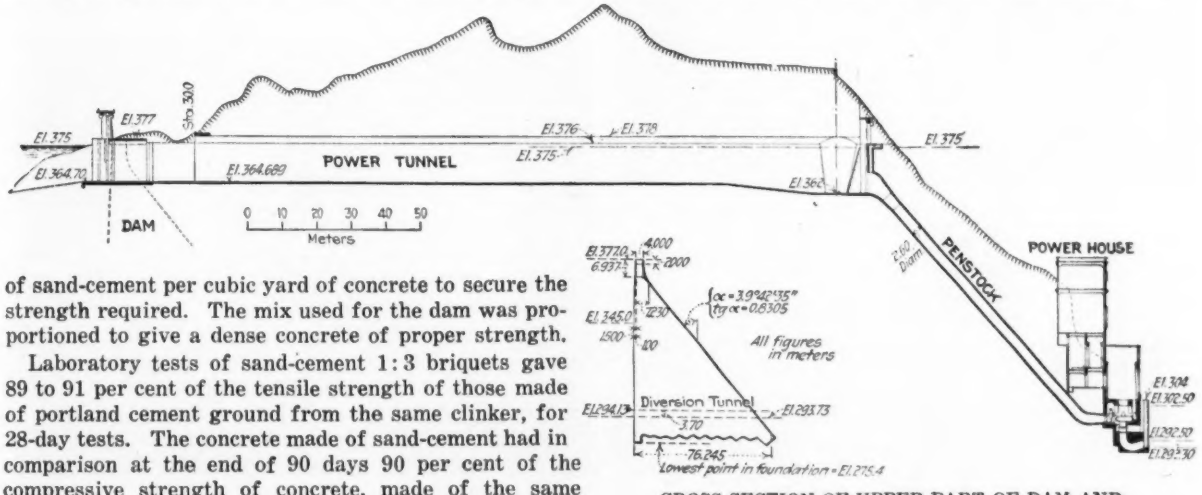
Laboratory tests of sand-cement 1:3 briquets gave 89 to 91 per cent of the tensile strength of those made of portland cement ground from the same clinker, for 28-day tests. The concrete made of sand-cement had in comparison at the end of 90 days 90 per cent of the compressive strength of concrete, made of the same fine and coarse aggregates, containing an equal weight of portland cement. Costing only 60 per cent as much per ton as the straight portland, the great saving effected by using sand-cement is obvious. With the exception of the base of dam below river level and the power house, it was used throughout the work and gave splendid results. The required amount of portland was either shipped in or ground from the clinker on hand.

The sand-cement for the job, after being ground, was stored in the bins long enough to determine the soundness. It was then conveyed in bulk from the released bin to supply pipes at mixers by a system of inclined pipes and screw-conveyors. In transit, it was weighed first at a central station a ton at a time and then weighed at each mixer in a balanced hopper before being dumped into the charging-hopper. This double check insured the use of proper amount. Coarse aggregate was measured in the charging-hoppers by filling up to marks whose volume gave the required weight closely. Fine aggregate was measured by volume of given weight in box-chutes. Experiments were made to determine a practical method of weighing the rock and sand which resulted in a solution by suspending the charging-hopper and adding a balanced sand-box. Mixing by weight gave slightly more uniform tests than volume measurement.

Dam Design and Construction—During the preliminary work, a tunnel (13 ft. square and 525 ft. long) was driven around the dam site at river level on the north side and lined with concrete to be used for diverting the normal flow of the Pallaresa during construction. It was completed in January, 1918, and the river was turned through early in February by means of a diversion dam which also served as the upper cofferdam for the foundation work.

A downstream cofferdam was built just above the tunnel outlet, the foundation area unwatered by pumps and excavation started. This was very difficult and costly as the river bed was full of immense boulders and the deepest bedrock was 83 ft. below the upper cofferdam level. Excavation totaled 11,300 cu.yd. of rock and 49,000 cu.yd. of gravel, boulders and clay. There were several floods which passed over the cofferdam requiring removal of equipment and abandonment of work for short intervals.

The big dam is of gravity section and arched on a radius of 1,000 ft. It is 333 ft. high, bedrock to crest, and contains 285,000 cu.yd. of cyclopean concrete. The width at base is 270 ft. and at crest 13 ft. The crest was widened to 21 ft. to provide a roadway and footwalks and the length on top is 460 ft. which will eventually be used as a river crossing for the projected highway from Camarasa to the French frontier. This road will reach the dam at either end by means of tunnels, short sections of which were driven so that future work would not endanger the spillway or headgate structures.

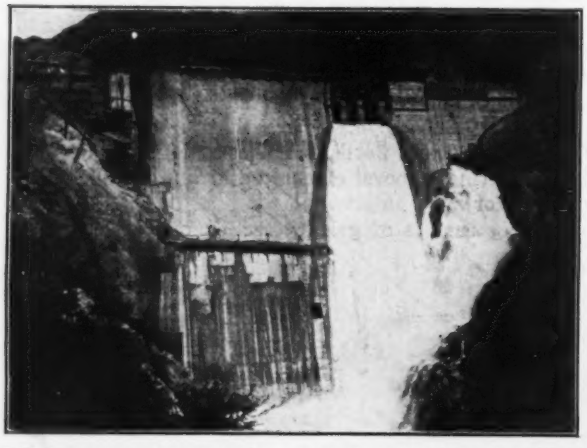


CROSS-SECTION OF UPPER PART OF DAM AND POWER TUNNEL TO POWER HOUSE

To meet the wishes of the government engineers, who wanted regular concrete for the zones of maximum pressure, portland cement concrete was used for the up and downstream toe sections below river level followed by a rich mix and sand-cement concrete.

Gravity chutes, with slopes not steeper than 30 deg. were used for placing the lower concrete direct from the mixers. Then various combinations were employed consisting of tower-hoists with chutes for upper levels, buckets on flat-cars either handled by electric-hoist on incline attached to downstream face or pushed along tracks paralleling mixer-plant to points where derricks or cableways could pick up and, when possible, direct

from mixer hoppers to buckets handled by the cableways. Most of the plums were placed by the cableways which handled the skips dumping rocks into the fresh concrete. They formed about 15 per cent of the cyclopean concrete of the dam and materially reduced its cost. Most of the concrete was placed by the day-shift and the second and third shifts completed the setting of plums, raised forms and cleaned up for the following day's run. Electric flood-lights were used for night work and their mobility made them much better



RESERVOIR DISCHARGING OVER PROVISIONAL SPILLWAY AND THROUGH TEMPORARY GATE

than searchlights. Steel forms, made up in panels reinforced by angles, held in place by channels were used for the up and downstream faces and, with wood fillers, for the cross-bulkheads. The amount of lumber for formwork was kept at a minimum and sawmill-slabs used whenever possible to cut costs.

After the lower concrete had become thoroughly set and seasoned, the diversion tunnel was closed by a reinforced-concrete gate lowered to place by motor-driven mechanism which was immediately removed. As the water rose, some calking was necessary and the tunnel was then filled, through a shaft from plum-track level, with concrete. Grout was forced in by placing pipes at roof level and a tight job secured. The reservoir filled rapidly until the level of the lower of the two small tunnels through the dam was reached. Their inlets were provided with steel flap-gates which had to be closed when the pressure-head above them exceeded 100 ft. The flow through these relief openings delayed the rise until a set of outlet gates and tunnel through dam near north abutment, providing a future lower penstock connection with reservoir, could be rushed to completion. This could have handled the surplus water but for shortage of labor which delayed the completion of spillway and it was therefore necessary to leave a temporary gap through the dam below that level which discharged at intervals. The successful control of the reservoir while it was filling was facilitated by the holding back of the 1920 floods in the Tremp reservoir, 20 miles above.

Expansion-joints, 52.5 ft. apart were provided in the upper 72 ft. of the dam by building this portion in regular alternate sections properly keyed.

Spillway—The spillway was a difficult problem requiring 161,000 cu.yd. of rock excavation. The narrow gorge location for the dam and the steep sides together with the need of space for the main construction plant made it necessary to put the south half of the outlet section in twin tunnels. Its north half is in open cut, taken out after the crusher-mixer plant and cement bins had been dismantled. The open excavation of the gate and intake sections is 141 ft. high on south side adjacent to cableway platforms above. The capacity of 70,000 sec.-ft. is secured through two gate openings, each 88.5 ft. wide, and temporary stoplogs were provided until the automatic drum-dam type reinforced-concrete gates could be installed.

Connecting Works—A logway, composed of a concrete chute in open cut and tunnel, is provided near the north abutment of dam to pass the logs coming down the Pallaresa from the mountain forests north of Pobla.

The flow of reservoir water to the power house is controlled by two headgates adjacent to north end of the dam. The water then flows through a short canal and long tunnel, the downstream end of which forms a forebay to feed the five penstocks. The total distance is 909 ft. on very light grade and both canal and tunnel, a

OVERFLOW THROUGH COMPLETED SPILLWAY DURING AUTUMN FLOOD, 1920

trapezoidal section 44.6 ft. high by 20.8 ft. wide, are lined with concrete. The penstocks are steel, 8.5 ft. in diameter, placed in tunnels with surrounding concrete. There are stopgates at upper ends and big gate-valves at turbine connections. The required excavation amounted to 55,650 cu.yd. and 10,280 cu.yd. of sand-cement concrete were used for linings and gate-structures. The total head developed, with reservoir full to within 6.5 ft. of the crest at the dam, is 270 ft.

Power House—Work on the foundation for the power house required the placing of a crib cofferdam which was built of logs forming three compartments, the outer and inner ones filled with rock and the center with clay puddle. Seepage was stopped with grouting like that employed in the cofferdams and steel sheet-piling was driven along the foundation lines using derricks and air-hammers. Bedrock was reached after much hard work in which pumps played an important part. The foundation concrete with draft-tube and turbine supports was then placed using chutes from a hopper fed by mixer plant on cliff above. Due to cramped location, the excavation was carried back into the cliff and the solid rock, faced with concrete, formed the back walls of the building. The power house is

179 ft. high. Excavation, from above roof level to foundations, totaled 21,900 cu.yd. and 16,800 cu.yd. of portland cement concrete were required. The structure consists of draft-tubes, turbine-room, generator-room with Melan-girder supports for machines and 70-ton traveling-crane, switchboard-room, offices, low-tension room, transformer room with 29-ton crane and the high-tension room which forms the top story. Derricks, chutes and tower-hoists were used for excavating and concreting.

Personnel—The personnel included the consulting engineer, H. F. Parshall, and the president of the company, E. R. Peacock, with headquarters in London, the construction manager, G. W. Caldwell, with offices in Barcelona and Balaguer, the advisory engineer, A. W. K. Billings, the managing director, F. Fraser Lawton, the chief operating engineer, A. C. Hobble, and hydraulic engineer, Walter Diem, at Barcelona. On the work at Camarasa, the writer was construction superintendent with Neal Hanson and John G. Hollman as his assistants.

Brick Used in Paving 34 Per Cent Grade

By A. W. Johns
City Manager, Ambridge, Pa.

THE enthusiasm of land companies and real estate agents of a generation ago in laying out town sites and lots with little consideration for topography has given city engineers days of study and worry in establishing grades that would make the streets of service.

The writer was city engineer of Monessen, Pa., a steel mill town on the Monongahela River about 40 miles from Pittsburgh, for several years. During that time many streets were paved on grades as high as 20 per cent and many tedious hours of study and planning were spent to overcome the difficulties of intersecting grades with cross streets, driveways, etc.

Hillside brick has been used with the greatest success for all paving on grades above 6 per cent. Horse-drawn vehicles make regular use of the streets with grades as high as 15 per cent.

Several of the streets of Monessen have grades that prohibit normal use for commercial and pleasure traffic. In fact some are so steep that it is necessary to provide steps instead of sidewalks for pedestrian traffic. The accompanying photograph of the pavement on the 34 per cent grade of Fourth St. between Schoonmaker Ave. and McKee Ave., shows the hillside brick paving laid in 1907 under the direction of John F. Irwin, then city engineer. There is a stretch of 174 ft. of 34 per cent grade on this street followed by 192 ft. of 28 per cent. While such a grade is obviously too steep to justify its use as a thoroughfare, the street is occasionally used by ambitious automobile salesmen to demonstrate the hill-climbing ability of their cars. It is also used by representatives of fire truck companies to demonstrate their machines to officials of surrounding cities.

The principal reason for paving Fourth St. was to prevent the washing of the street and the consequent damage and expense of cleaning the adjoining streets at the foot of the hill after every rain.

In the construction of the pavement an 8-in. gravel base was used, with a 2-in. bedding course of sand, and 4-in. repressed hillside brick with cement grout filler. At intervals of approximately 40 ft. headers of curb stone 20 in. deep were placed transversely to prevent the washing out of the base course and consequent undermining of the pavement, and to prevent the creeping or slipping of the pavement.

The contractors on this work, Bowman Bros. Co., McKeesport, Pa., built the pavement in about 40-ft. sections beginning at the top of the hill. They first placed the transverse curbing about 40 ft. below the crest and then laid the base, bed, and brick from there to the top. After this section had been grouted another transverse header was placed 40 ft. below the first one and the pavement then completed to meet the first section. As

174 FT. OF STREET WITH 34 PER CENT GRADE

it was impossible to use a roller on this grade, the base course and brick surface were brought to line and grade by hand tamping.

The writer has seen and heard of several streets paved with grades as high as 30 per cent, but to his knowledge this street is the steepest one of which there is general knowledge.

Deferrization of Part of London Water Supply

Removal of iron by aëration and mechanical filtration, using polarite and sand as the filter medium, has been adopted by the Metropolitan Water Board of London, England, for water taken from wells at Waltham Abbey and Rammey Marsh. Twelve Candy filters, 8½ ft. in diameter and about 7 ft. high, two of which are to serve as stand-bys, are expected to treat 2 Imp.m.g.d. According to the London *Engineer*: "A small quantity of compressed air will be injected into the unfiltered water for the oxidization of the iron in solution. The polarite acts as a catalytic agent, transferring the dissolved air to the iron, with which it combines to form an insoluble hydrated oxide of iron. By this means it is hoped to reduce any iron which may be contained in the water to be treated to 0.01 parts per hundred thousand."

Louisville Sewer Specifications Modified for Contractors

Contractors Refuse to Bid on Alleged Unfair Specifications—Commission Agrees to Act as Court of Review

AFTER contractors had refused to bid on two sewer contracts offered by the sewerage commission of Louisville, Ky., on May 23, on the alleged ground that the specifications were unfair to the former, conferences were held between the commission and its engineers on the one hand and representatives of the Kentucky Association of Highway Contractors on the other, which finally led to concessions on practically all of the specification features held by the contractors to be objectionable. After a second advertisement the commission received ten bids. An account of the incident appears in *The Scraper* for June 30. (The publication named is the official organ of the association just mentioned and is published at 523 Court Place, Louisville, Ky.) A condensation of the earlier portion of the account mentioned is given immediately below, followed by a summary of many of the points at issue and the way in which they were settled, the summary being reprinted verbatim from *The Scraper*.

The commission of sewerage of Louisville is a special branch of the government of that city created to make extensions to the sewers built under an earlier commission. The present commission consists of four business men of Louisville, appointed by the mayor of the city, and the mayor himself as member ex officio. J. B. F. Breed is chief engineer to the commission, and Harrison P. Eddy of Metcalf & Eddy, Boston, Mass., is consulting engineer. The Kentucky Association of Highway Contractors was formed in 1921 for the protection and advancement of the business of highway contracting. David R. Lyman is secretary of the association with headquarters at the address given above.

In the official statement in *The Scraper* it is stated that in November, 1921, the association offered its assistance to the commission in the drawing of sewer specifications under which the commission was to receive bids for the first time but that the offer was not accepted. Early in 1922 bids were received and a contract was awarded. Bids were invited for a second letting on May 23, 1922, but none was received. A conference was immediately held at which the contractors submitted to the commission criticism of 22 sections of the contract and specifications for the second letting. On 19 of these suggestions concurrence was secured; on two, "of minor importance" according to *The Scraper*, there was no modification of the original requirements, and on the other suggestion a compromise was effected.

This last point of difference was apparently the most important of the lot, and the one on which the contractors were prepared to make the greatest fight. It concerns the clause in the contract denominating the engineer as the court of last resort in matters of dispute. This clause read as follows:

Engineer to Decide—To prevent disputes and litigation, the engineer shall in all cases determine the amount, quality, acceptability and fitness of the several kinds of work and materials which are to be paid for under this contract; shall determine all questions in relation to said work and the construction thereof, and shall in all cases decide every question of fact which may arise relative to the fulfillment of this contract on the part of the commission and on the part of the contractor. His estimate and decision shall be final and conclusive upon both parties to this contract.

The contractors contended for the substitution of a general arbitration clause covering all matters of dispute. After considerable discussion the commission agreed to modify the clause so that the contractor was granted the right of appeal *to the commission* for adequate compensation for executing the orders and abiding by the interpretation of the engineer. In respect to this modification the contractors' organ says, "We negotiated a compromise sufficiently satisfactory to our members to justify them in feeling their way through at least one contract."

Points at Issue—The review of the points at issue, as given in *The Scraper*, is as follows:

In the original contract the commission did not guarantee the correctness of its borings as shown on the plans. These are now guaranteed.

The contractor was required to negotiate with a railroad company for permission to construct a sewer across its right-of-way and to do the work as directed by the railroad company. The commission now makes all arrangements with the railroad and specifies the methods to be followed in construction.

The engineer of the commission was originally given the final decision in any controversy. This has been modified by providing an appeal to the commission in matters of compensation as above mentioned.

The original contract provided that the engineer should have the right to correct any errors or omissions in the drawings or specifications without reimbursing the contractor for any additional expense thereby incurred. This has been changed so as to provide compensation.

Provision was made in the contract for furnishing additional time to the contractor because of delays caused by the commission but provided no additional compensation if the contractor were damaged. This has been corrected.

The contract placed on the contractor a blanket responsibility to defend the commission in any legal action directed against it even to a defense arising from the exercise of eminent domain. This has been changed so that the contractor is not responsible for any act or omission of the commission.

To cover a one-year maintenance period the contractor was asked to deposit city or United States bonds which, at our suggestion, has been modified so as to give him the option of filing a surety bond.

The original contract required the contractor to take all risk of encountering underground objects. This provision has now been changed so that the contractor will be reimbursed if he encounters an underground structure not shown on the drawings and which necessitates supporting or change of location for a distance of 50 ft. or more.

Much of the solid rock formation in Louisville consists of a very irregular surface thickly covered with rock pyramids or pinnacles with deep and narrow depressions between. The specifications did not clearly state how the quantity of rock in such formation would be calculated. It is now provided that the contractor will not be required to excavate these pockets below a line which is 2 ft. long between rock faces. Earth below this line will be paid for as solid rock.

The specifications originally required the contractor to import earth, sand or gravel for filling around the pipe if such could not be obtained from the excavated material. It was manifestly impossible for the contractor to know until the trench was excavated whether the material would be suitable. This section has been re-written so that the contractor will be paid for material secured from the outside.

In the contract as drawn, the contractor was to be paid

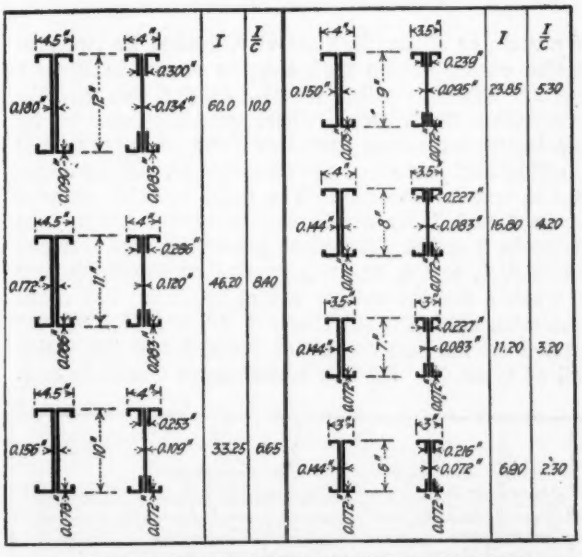
for piles only for the length left in the ground. This has been modified so as to pay him one price for the length in the ground and another price for the portion cut off.

Payment for timber left in place was originally to be based on the "actual" thickness of the lumber. This has been altered so as to pay him on the commercial basis prevailing in the lumber market.

The original plans of the commission for work in rock trench required the contractor to fill back to grade at his expense with concrete. This has been modified so as to permit filling at his expense with broken stone or earth and, if ordered by the commission, with concrete at its expense. It was also agreed to provide a separate classification in rock excavation in very narrow excavations as necessary for under-drain. For replacing waterbound macadam paving the original requirements for 4-in. screenings was changed to 2-in. as it was impracticable to work 4-in. into the coarse stone.

Manufacturers of Pressed Steel Joists Standardize Sections

IN AN effort to simplify the problems of engineers, architects, and others who use pressed steel joists, and who are likely to have occasion to consider the alternative use of the joists of different manufacturers, the three principal producers in this field have co-operated to establish sections of uniform mechanical properties. The result is a standard table of moments of inertia and section moduli, applicable to the shapes of the Berger Mfg. Co., the National Pressed Steel Co. and the Truscon Steel Co. interchangeably.



STANDARDIZED BENDING VALUES OF PRESSED-STEEL JOIST

The standardization does not cover all details of the sections, such as thickness and sectional area, but does cover the bending constants. Two different types of section are manufactured at the present time, a built-up plate-girder section and an I-beam section composed of two channel shapes spot-welded back to back. The principal sizes of both forms of section are shown in the sketch herewith, prepared by M. P. Wright, manager of the Building Materials Division of the Berger Mfg. Co. The shapes represented in this diagram range from 12 in. to 6 in. in depth, but the standards go down to sections of 3-in. depth.

With the standardization of section properties there has also been some increase in thicknesses, the new standard sections being fairly stocky.

The moments of inertia and section moduli are also given on the diagram. These quantities, as above noted, are standard for the three makers. It was found necessary to carry the standardization farther as the important objective was to maintain a fixed bending strength in a joint of given depth. By virtue of the standard bending value the designer using a 10-in. joist, for example, will now be able to count on the same carrying capacity whether the joist is procured from one manufacturer or another. On the other hand manufacturing facilities in the several plants make it more convenient for one plant to form its shapes from a wide strip while another prefers to work up the narrower strips used in the built girder section.

Tables of cross-sectional dimensions and carrying capacities are issued by the several manufacturers applicable to the new standards. The tables of carrying capacities are the same for the different manufacturers, being based on the standard section moduli.

Idle Water Main Converted Into New High-Pressure Feeder

By Leland Chivvis
Engineer in Charge, Distribution Section, Water Division, St. Louis, Mo.

PITOMETER records taken in St. Louis have shown for some years that the 36-in. low-pressure pump main across Twentieth St. has not been carrying much water at points beyond Cass Ave. For some reason, unknown at present, the greater part of the flow turns east between Hebert and North Market Streets, and by the time the Mill Creek Valley is reached the main in question is carrying a small flow back toward the pumps. This situation was seen to have great possibilities when it became necessary recently to lay out a route for a high pressure main to take the discharge of a new 20-m.g.d. pump away from the Bissell's Point Station. It was made still more attractive by the fact that the existing main leads directly into one of the three high-pressure districts where pressures have been low.

Briefly, the plan proposed is to connect the new pump to the old main and to substitute a new line of 36-in. low-pressure main along a more direct route for that part of the old main which was carrying its full share of the load southward.

The old records showed that several miles of the main were laid with St. Louis Class A pipe, which is only a little heavier than American Water Works Association Class B pipe. As most of our large breaks have occurred on lines of this weight a test was made to ascertain the soundness of the pipe. During two of the coldest months of the winter an extensive "shut" was made, which threw the entire Class A portion of the line on high pressure and incidentally demonstrated the ability of the remainder of the system to carry the winter peak load without its aid. The only trouble due to the increased pressure was a cracked sleeve.

Additional pitometer taps are being put in at selected points in order to trace more exactly the course which the water is now following, These data may modify the design here and there, but it is very probable that the finished project will bear a striking resemblance to the first conception.

Dismantle Jersey City Trainshed of Pennsylvania R. R.

Trusses of 252-Ft. Span Cut by Blow-Flame and Removed Under Traffic—When Built Was Largest Trainshed

AFTER dominating for more than thirty years the New Jersey shore of the Hudson River at New York, the Jersey City trainshed of the Pennsylvania R.R. has been dismantled. This follows as a natural consequence the diversion of the main stream of Pennsylvania passenger traffic to the 33rd Street terminal on Manhattan Island, New York City.

As originally built in 1891, the Jersey City shed was a wrought-iron riveted structure consisting of twelve pairs of main roof trusses designed as three-hinged arches with a span of 252 ft. 8 in. between centers of end pins. The lateral thrusts at the points of support were taken by lower chords or tie beams each consisting of an I-beam weighing 100 lb. per yard connecting opposite end pins. These passed under all the tracks, having their top surfaces 1 ft. below base of rail. The shed was 652 ft. 6 in. long and 256 ft. wide, with a clear height at the center of 86 ft. The height from the top of rail to the ridge monitor was 110 ft. Twelve tracks and eight platforms were under the shed arranged as shown in Fig. 1. At the river end was a lobby from which access was had to the waiting room, the ferry slips, and, of recent years, to the elevators to the Hudson tunnels beneath the station.

The distance between the two trusses of each pair was 14 ft. 6 in. and the distance betwen the pairs of trusses was 43 ft. 6 in. Purlins 3 ft. in depth, framed into the main trusses at the panel-points, spanned the distance between the pairs of main trusses and supported intermediate trusses, spaced 14 ft. 6 in. apart.

The shed was designed by C. C. Schneider, detailed by the Pencoyd Bridge & Construction Co. and erected by the Pennsylvania Railroad Co. under the direction of William H. Brown, chief engineer. At the time of its construction it was the largest trainshed in existence, the next largest being that of St. Pancras in London, which had been built twenty-five years earlier and spanned 243 ft. Except for the roof of the machinery hall at the 1889 Paris Exposition, which was 364 ft. 2 in. in span and 1,390 ft. in length, the Pennsylvania shed was at the time it was built the largest single-span roof on record.

In 1899 the shed was extended in length 125 ft. at the river end. In the new section the same type of construction was used but the material was steel instead of wrought iron. The total length of the shed, then, at the time of its removal was 778 ft.

The plant used in dismantling the trainshed consisted of a main or dismantling traveler, flanked by two protection sheds, one on each side, as shown in Figs. 1 and 2. The dismantling traveler carried two derricks each with a 60-ft. boom. These were supplemented by two locomotive cranes operating from the ground and handling that portion of the structure beyond the range of the traveler derricks. The main traveler spanned tracks 6 and 7, its wheels resting on the inside rails of tracks 5 and 8. The south protection shed spanned tracks 2, 3, and 4, and was carried on the inside rail of track 1 and the outside rail of track 5. The north protection shed spanned tracks 9, 10, and 11, and was carried on the outside rail of track 8 and the inside rail of track 12. By this arrangement tracks 2, 3, 4,

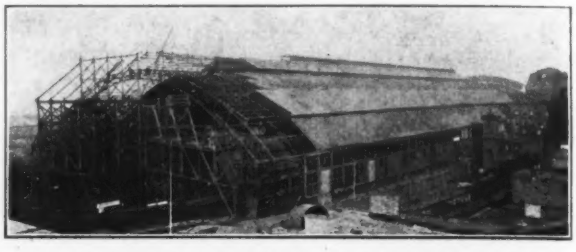


FIG. 4. GENERAL VIEW OF TRAINSHED SOON AFTER COMMENCEMENT OF WORK

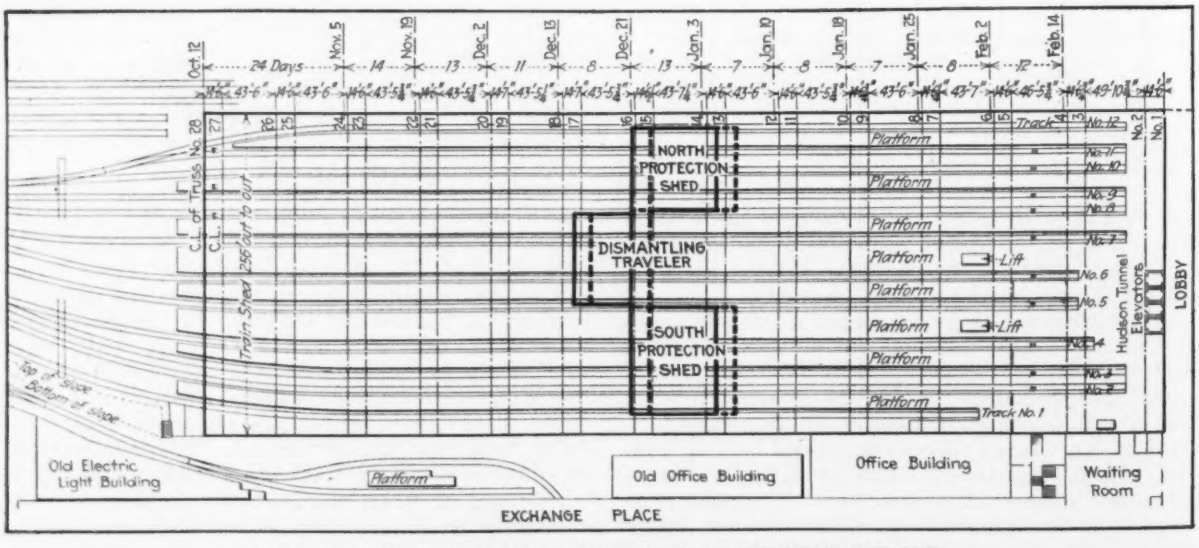


FIG. 1. GENERAL PLAN OF TRAINSHED AND DISMANTLING PLANT

The dismantling traveler and the protection sheds are shown in full lines as set to remove main truss No. 16 and the bracing between trusses Nos. 16 and 15. They are shown in broken lines as moved up to handle truss No. 15 and the purlins, intermediate trusses and bracing between trusses Nos. 15 and 14. Above the plan are shown the dicated points.
dates on which the various operations had reached the in-

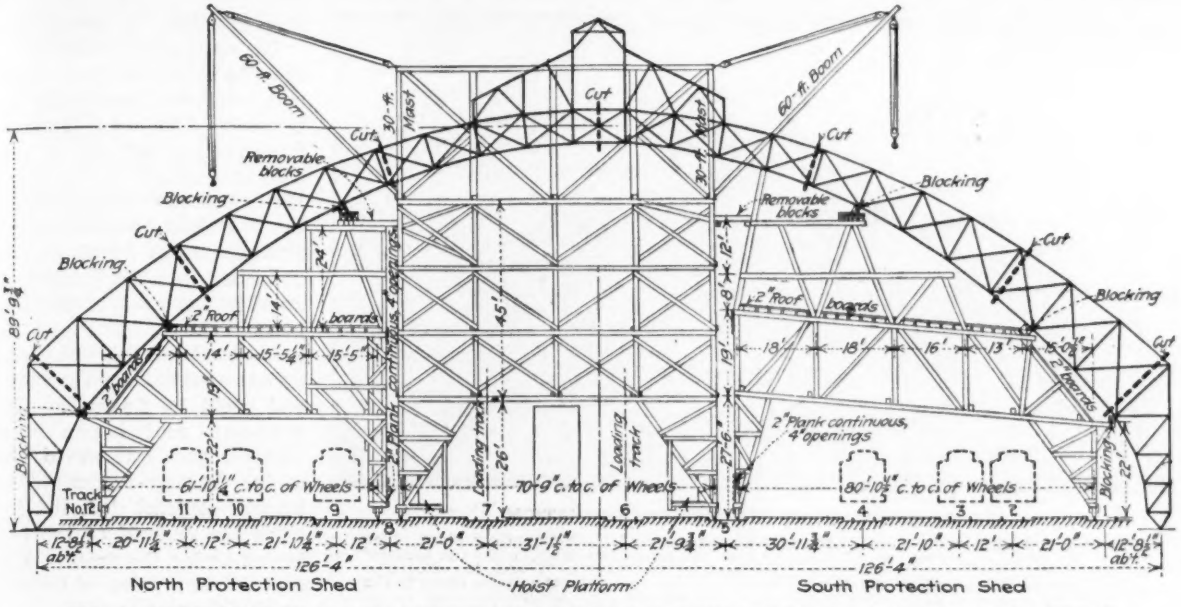


FIG. 2. CROSS-SECTION OF TRAINSHED SHOWING DISMANTLING TRAVELER AND PROTECTION SHEDS

The cuts at the center hinge and next on each side of it were made with the traveler derricks holding the two center sections of the truss. The sections next lower were handled in the same manner, while the lowest two sections on each side were handled by locomotive cranes on tracks 1 and 12. The tracks on which are shown cross-sections of cars were kept in service to handle railroad traffic while tracks 1, 5, 6, 7, 8, and 12 were used by the contractor.

9, 10, and 11 were left free to handle railroad traffic, tracks 6 and 7 were used as loading tracks for the main traveler, while tracks 1 and 12 were occupied by the locomotive cranes which swung the lowest sections of the trusses. All this is clearly shown in Fig. 2.

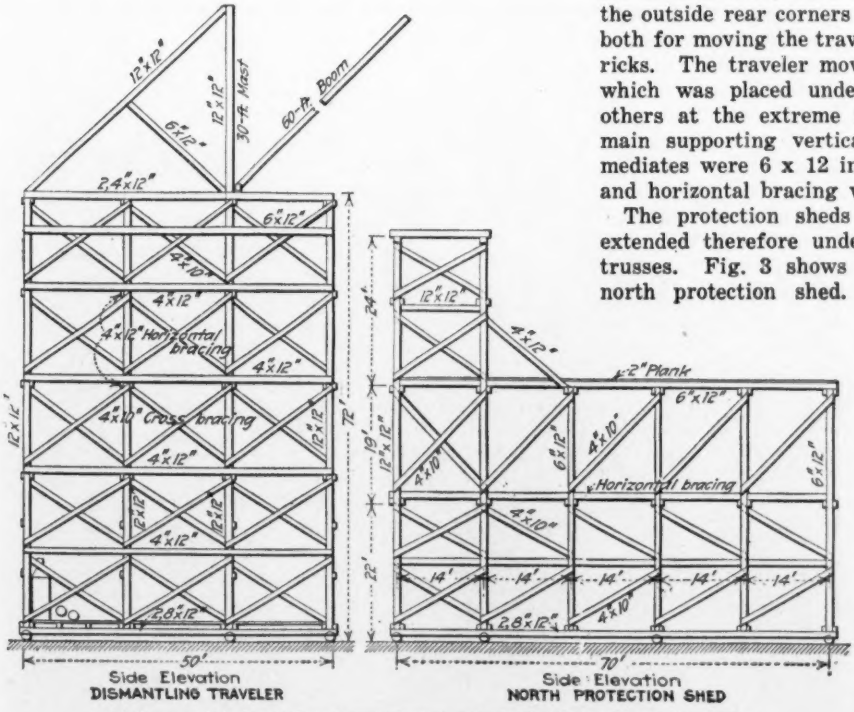


FIG. 3. LONGITUDINAL SECTIONS OF DISMANTLING TRAVELER AND PROTECTION SHEDS

Here are shown details of the traveler and shed construction. The derrick masts were braced by wire rope guys from their tops to the rear corners of the traveler on the opposite sides. The extension trestles on the rear end of the protection sheds afforded support for the trusses while they were being cut. The south shed was of somewhat different lines as shown in Fig. 2.

As shown in Fig. 3, the main traveler was approximately 71 x 50 ft. in plan and 72 ft. high and was equipped with two derricks. Each of these had a 60-ft. boom and a 30-ft. mast braced by stiff-legs and cross-braced by wire rope guys. Two hoisting engines, one for each derrick, were installed on hoist platforms at the outside rear corners of the traveler, and were used both for moving the traveler and for operating the derricks. The traveler moved on six wheels, one pair of which was placed under the derrick masts and the others at the extreme forward and rear ends. The main supporting verticals were 12 x 12 in.; intermediates were 6 x 12 in., and the lateral, longitudinal and horizontal bracing were, in general, 4 x 10 in.

The protection sheds were about 70 ft. long and extended therefore under two adjacent pairs of roof trusses. Fig. 3 shows a longitudinal section of the north protection shed. The south protection shed was similar in general design but its cross-section was varied slightly owing to the unsymmetrical layout of the plant with respect to the cross-section of the trainshed. The protection sheds were framed in general with 6 x 12-in. main members in the north shed and 8 x 12-in. in the south shed, the bracing in both being 4 x 10-in. material. They were considerably heavier at their rear ends, where they carried an extension trestle sufficiently high to support the main trusses while they were being cut. The main verticals here were 12 x 12 in. The tops and sloping sides of the protection sheds were sheathed with 2-in.

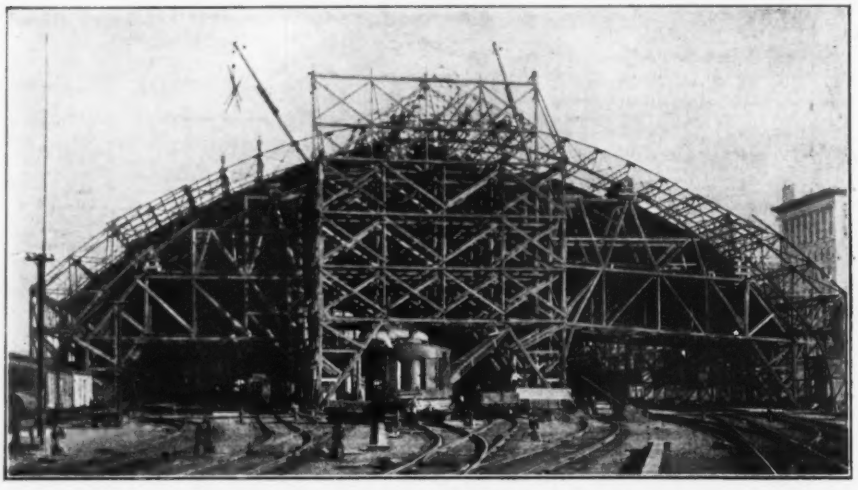


FIG. 6. END VIEW OF DISMANTLING OPERATION

Here is shown clearly the construction and arrangement of the dismantling plant. The lower ends of truss No. 28 are still supported on the protection sheds, while the traveler derricks are removing small members from between trusses No. 27 and No. 26. The purlins, intermediate trusses and bracing have been removed from the center down to the point at which the man is standing to the left of the derrick. The locomotive crane in the center is loading scrap. The cranes that handled the lowest sections of the trusses are not shown.

boards, and the vertical sides were covered by continuous 2-in. plank slats with 4-in. openings. These sheds were supported on eight wheels, of which four were concentrated at the rear under the supporting trestles, two were at the extreme front end, and two were midway between the front end and the supporting trestles. The relative positions of the main traveler, protection sheds, and trusses, while dismantling was in progress are indicated in Fig. 1. The sequence of operations was to remove at one set-up of the traveler one main truss of a pair and the longitudinal bracing between the two trusses composing the pair. The traveler was then moved up 14 ft. 6 in. and from the new set-up the second truss of the pair was removed together with the purlins, intermediate trusses and bracing between it and the next pair.

Each main truss was cut in seven places, thereby forming eight sections. Four of these were handled from the main traveler and two by each of the traveling cranes on tracks 1 and 2. The heaviest section handled weighed about 4 tons. The first section of the main truss was removed on Oct. 12, 1921, and the progress thereafter is indicated on Fig. 1. Two thousand gross tons of metal were handled, of which about 200 tons were of steel. This was burned into charging sizes not to exceed 18 in. x 24 in. x 6 ft., and the wrought iron was cut into convenient sizes for shipping. All cutting was done by blow-flame.

The contractor entered upon the site in the middle of July and commenced operations by removing the end hangers from the western end of the shed and stripping the sides. He commenced also to build the travelers on the outer tracks under cover of the trainshed. In the beginning, an effort was made to save the glass in the roof and the ends of the shed, but this was given up as no market for the material could be found. The wooden roof beams were bundled and lowered to the center loading-tracks. The present contract does not include the removal of the tie-beams under the track. Except for two pairs of trusses at the river end, which were left standing until underpinning could be provided to support the roof of the lobby, which had been framed into them, the demolition was completed by the middle of February, 1922.

The work was done under the direction of A. C. Shand, chief engineer of the Pennsylvania Railroad, by Henry A. Hitners Sons Co., contractors, of Philadelphia. Theodore I. Etter was superintendent for the contractor.

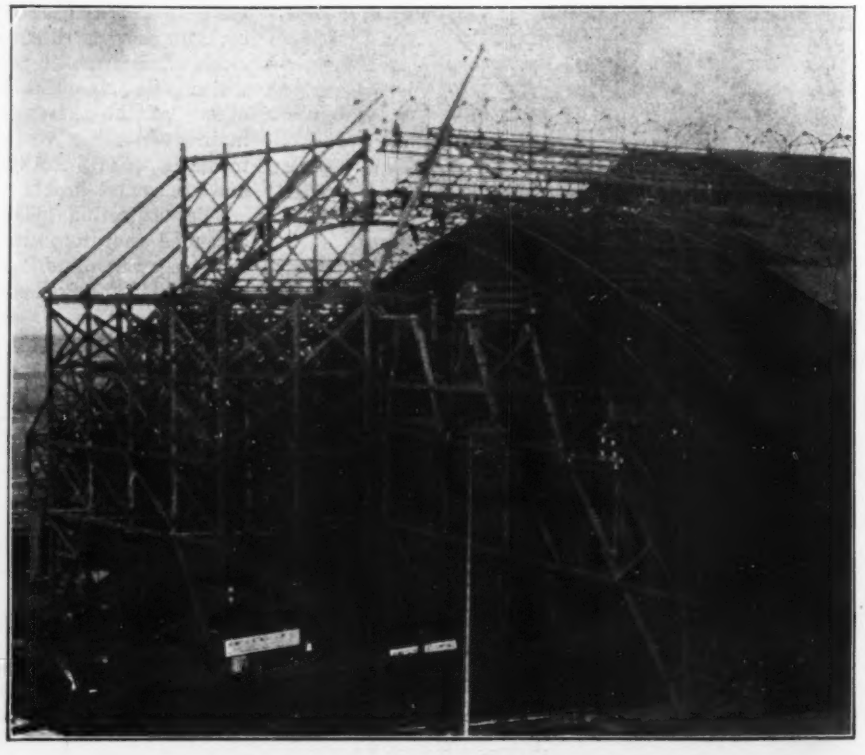


FIG. 5. CLOSE-UP VIEW OF DISMANTLING OPERATION

The center four sections of truss No. 28 have been removed and the traveler derricks are preparing to take hold of the center two sections of truss No. 27. The remaining sections of truss No. 28 are supported on the protection shed.

Detour Practice Standardized on Ohio State Roads

Engineering Department Locates and Marks Detour Routes—News Bulletins and Maps of All Detours Published Periodically

DETOUR practice is intensively developed in Ohio. Highway improvement there is a task of filling in gaps in a system which is already state-wide. It follows that construction consists of numerous small-mileage, widely-scattered operations, and consequently, that detours are numerous and widely-scattered and that their sufficiency comes under the observation of the people in all portions of the state. Efficient methods are therefore required to meet the situation so as to avoid criticism. These methods cost in 1921, when work amounting to $35,000,000 was under way, about $200 per county for 88 counties, and perhaps $4,000 a year in main office expenses.

Practice in Ohio in detouring traffic around sections of road which is being improved keeps in mind primarily (1) that the location and maintenance of detours must be such that travel is not unnecessarily inconvenienced; (2) that news that detours are established must be prompt and complete and (3) that the marking must be so clear that strangers to the locality can easily follow the route.

Detours are located, maintained and marked by the highway department engineers. The only task imposed on the contractor is to erect and maintain barriers. This practice keeps responsibility centralized. In the matter of location, the instructions are, where choice is possible, to search out the best detour route, taking into account the condition of the roads as well as the mileage. Where the detour route is over dirt roads, as it commonly is, the roads are kept in condition by dragging and such other work as will make possible traveling without excessive cost.

With the detour selected, the proper signs and barriers and their location conform as closely as possible to a standard arrangement as indicated by the sketch, Fig. 1. The specifications for signs and their location

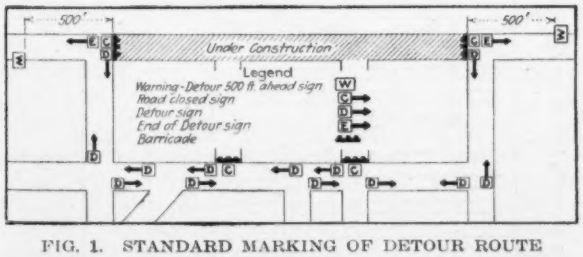
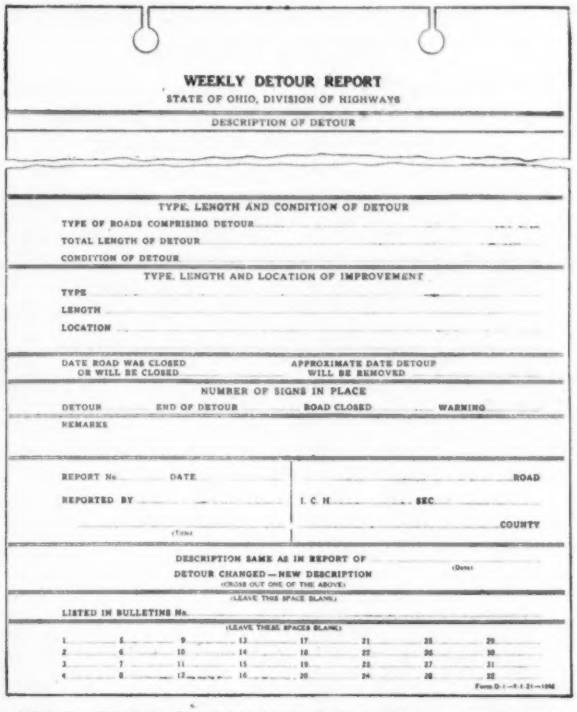


FIG. 1. STANDARD MARKING OF DETOUR ROUTE

are rigidly enforced and cover every detail of constructing the standards and attaching the printed placard, 18 x 27 in., of white on dark blue. The specified standards are 19 x 28 in. "boards" on 4 x 4-in. posts 7 ft. long. The placards are tacked to the boards by border strips of wood. Boards, posts and strips are painted white and the placards are coated with paraffine. A weekly inspection is made and when necessary the signs are restored or replaced.

The fundamental rules governing the marking of detours are: (1) a road shall not be closed to traffic until all signs necessary to indicate clearly the route of the detour, are in place; (2) when a road which has been closed is permanently opened to traffic all detour signs shall be promptly removed, and (3) all barricades shall be painted white and have red lights between sunset and sunrise.


WEEKLY DETOUR REPORT
STATE OF OHIO, DIVISION OF HIGHWAYS

DESCRIPTION OF DETOUR

TYPE, LENGTH AND CONDITION OF DETOUR
TYPE OF ROADS COMPRISING DETOUR
TOTAL LENGTH OF DETOUR
CONDITION OF DETOUR

TYPE, LENGTH AND LOCATION OF IMPROVEMENT
TYPE
LENGTH
LOCATION

DATE ROAD WAS CLOSED OR WILL BE CLOSED
APPROXIMATE DATE DETOUR WILL BE REMOVED

NUMBER OF SIGNS IN PLACE
DETOUR | END OF DETOUR | ROAD CLOSED | WARNING

REMARKS

REPORT No. DATE
REPORTED BY
(Title)
ROAD
I. C. H. SEC.
COUNTY

DESCRIPTION SAME AS IN REPORT OF (Date)
DETOUR CHANGED — NEW DESCRIPTION
(CROSS OUT ONE OF THE ABOVE)
(LEAVE THIS SPACE BLANK)

LISTED IN BULLETINS No.
(LEAVE THESE SPACES BLANK)

FIG. 2. STANDARD FORMS FOR REPORTING DETOURS

As soon as a detour is marked it is reported by the division engineer on the form shown by Fig. 2. In this report particular attention is given to the description of the detour. This is circumstantial and precise to the extent of noting every surface condition or other physical characteristic of concern to travelers. After the first report a weekly report noting all detour changes is made until the detour is abolished.

On the information provided by the detour reports, a map and bulletin are prepared each month and copies are placed at division offices and in garages where travelers may consult them. Each monthly bulletin is corrected each week by a supplement recording changes and additions. This news service is maintained with exactness and has proved to be popular.

Selection, marking and maintenance of detours are the tasks of the division engineers conforming to the practice established by commission headquarters. Headquarters prepares the monthly detour news, maps, and bulletins, and arranges for their circulation. Leon C. Herrick is director of the department of highways and public roads, and E. C. Blosser highway engineer.

Large Venturi Meters for London

Venturi water meters, each 108 in. in diameter and the whole group having a capacity of 360 U. S. m.g.d., have been contracted for by the Metropolitan Water Board of London, England. *Municipal Engineering* of London states these will be the largest Venturi meters ever installed in the United Kingdom and the second largest ever built in that country, the largest being 120 in. in diameter, built some fifteen years ago for the Divi Irrigation Works, Madras.

Slenderness-Ratio and Strength of Concrete Columns

Effect of Length Found To Be Negligible—Influence of Water Ratio and Mixing — Buckling Controlled by Eccentric Loading

By F. E. Giesecke
Head of Engineering Research Division, University of Texas, Austin

VARIOUS regulations or formulas to express the relation between strength and slenderness-ratio of reinforced-concrete columns are in current use. The most important ones known to the writer fix the relation between allowable load on long columns (P') and on short columns (P) as follows:

1. French regulations of 1906, for l/d greater than 20,

$$P' = \frac{P}{1 + \frac{k}{10{,}000}\frac{l^2}{r^2}}$$

in which k is ¼ for square-ended columns and 1 for round-ended columns.

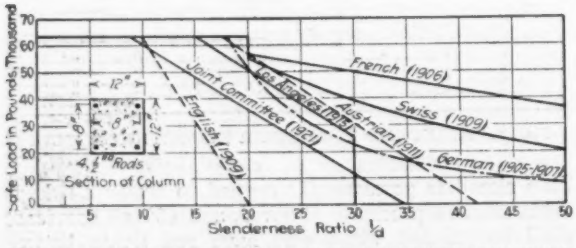


FIG. 1. SAFE LOADS ON 12 x 12-IN. CONCRETE COLUMNS UNDER DIFFERENT REGULATIONS
Computed for equal base stress

2. German regulations of 1905 and 1907, for l/d greater than 18,

$$P' = \frac{\pi^2 E I}{s\, l^2}$$

where s, the factor of safety, is 10 in the German regulation.

3. English regulations of 1909, fix values of P'/P for ratios of virtual length to effective diameter of a square pillar ranging from 15, 18, 21, 24, 27, 30 at 1, 0.8, 0.6, 0.4, 0.2, and zero. The virtual length of the column varies from l to $4l$, depending on end conditions; the effective diameter is measured to the outside of the outermost vertical reinforcement.

4. Swiss regulations of 1909, for l/d greater than 20.

$$P' = \frac{45}{35}\frac{P}{1 + \left(\frac{l}{100\,r}\right)^2}$$

5. Austrian regulations of 1911, for l/r greater than 60,

$$P' = P\left(1.72 - 0.012\frac{l}{r}\right)$$

6. Los Angeles regulations of 1915, for l/d greater than 15,

$$P' = P\left(1.6 - \frac{l}{25d}\right)$$

7. Joint Committee, in its tentative specifications of 1921, for l/r greater than 40,

$$P' = P\left(1.33 - \frac{l}{120\,R}\right)$$

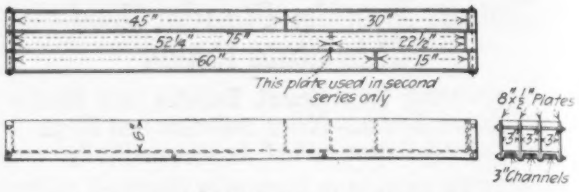


FIG. 2. GANG MOLD FOR 3 x 6-IN. COLUMNS
Upper edges of plates held together by clamps until concrete was set.

where R is the least radius of gyration of the core.

In order to be able to compare these six formulas, the strengths of 12-in. square columns of various lengths, reinforced with four ½-in. square bars 7½ in. on centers, were calculated by each of the six formulas, for equal loads on short columns. The results, plotted in Fig. 1, indicate that the French and Swiss regulations are based on Rankine's formula and the German regulations on Euler's formula, while the Austrian, Los Angeles, Joint Committee, and English rules seem to be straight-line approximations of Euler's formula.

Since there is a considerable variation in the results it was decided to make experimental determination of the strength of plain concrete columns, and a series of tests was begun by the Engineering Research Division of the University of Texas in 1919.

Test Procedure.—The columns tested were 3 x 6 in. in cross-section and varied in length from 15 to 75 in., so that the slenderness-ratios were 5, 10, 15, 20, and 25. They were made in molds formed by bolting 8 x ½-in. steel plates to 3-in. channels and inserting dividing plates to limit the lengths of the columns (Fig. 2). The columns were thus poured from their sides. As all columns of a series were made at the same time, the character of the concrete was exactly the same in any one series.

Eight such series were prepared, differing in mix and consistency. In some of the groups the concrete was rodded; in others it was tamped. The columns were

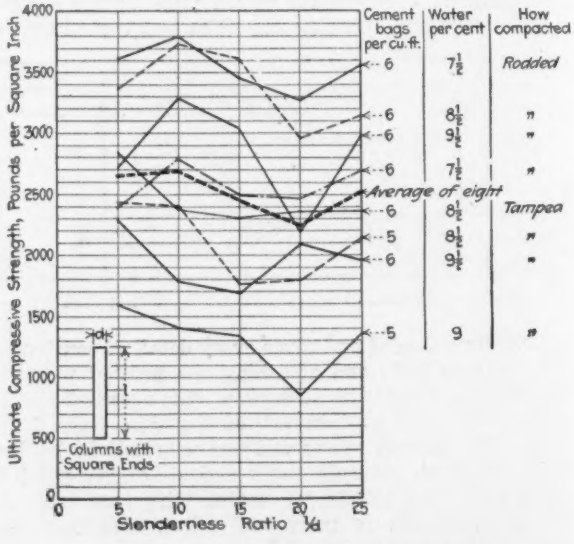


FIG. 3. SQUARE-END TEST RESULTS
Each point of the full lines represents one column; the dash line is the average of the eight series. Maximum size of aggregate 1½ in. in Series 1, ¾ in. in others. Reading from top down on right hand side, series numbers are 2, 4, 6, 1, average 3, 7, 5 and 8.

tested at the age of 28 days. The results of this series of tests are shown in Fig. 3.

Inspection shows that the strength of these concrete columns varied only slightly with the slenderness-ratio, which, however, did not exceed 25; but it also shows that a variation in the consistency of the mix, or a variation in the degree of richness of the mix, or a variation in the method of placing the concrete may produce a very great variation in strength, more than 100 per cent.

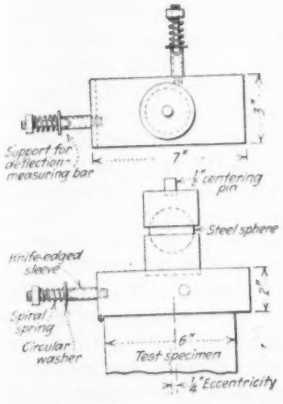


FIG. 4. END SUPPORT FOR ROUND-END COLUMNS
Eccentricity adjusted to prevent buckling in 6-in. direction.

Round-End Tests—Since these columns showed such a slight variation in strength with slenderness-ratio, it was decided to repeat the experiment on round-end columns between spherical bearings. This method of testing would insure central loading and would double the virtual length and therefore the slenderness-ratio of each column. For this purpose the bearing blocks shown in Fig. 4 were constructed. Since the addition of the two bearing blocks made the longest column of the first group too long for the testing machine, that column was divided into two parts (dotted line in Fig 2). Thus each series of the 1920 group consisted of six round-end columns having slenderness-ratios of 7.34, 9.75, 12.25, 17.17, 19.63, and 22.13, or, for the equivalent square-ended columns, 14.68, 19.5, 24.5, 34.34, 39.26, and 44.26.

For each series one or more 6 x 12-in. cylinders were made to identify the type of concrete. Five series of columns were made in the fall of 1920 and tested during the summer of 1921, at an average age of about 9 months. Each series consisted of five sets of columns, and the entire group consisted of 150 columns. The five series differed from each other in the type of concrete. In all, more mixing water was used than was necessary, in order that the experimental columns might be no better than those generally found in practice.

Anomalous Buckling—When the testing of the columns was begun, it was found that the columns bent in the 6-in. direction instead of in the 3-in. direction, as in Fig. 5, showing a column 15 in. long; it is evident that this column failed by flexure in the 6-in. direction. This peculiar condition was concluded to be due to the fact that the columns were poured from the side and into fairly tight steel forms, and that therefore the concrete on the upper side of the column contained more mixing water than that in the lower side; the strength effect of water content was sufficient to overcome that of slenderness-ratio.

In order to test the columns satisfactorily, it was necessary to apply the load eccentrically about ¼ in., as shown in Fig. 4. This degree of eccentricity seemed to be just sufficient to overcome the effect of the variation in the strength of the concrete in the direction of the width of the columns.

Fig. 6 shows the results of the tests of this group. The lengths used in this diagram are the actual lengths of the specimens from center to center of the spherical bearings; the virtual lengths are twice as great.

Results—The diagrams of Figs. 3 and 6 show that, for the limits of slenderness-ratio examined, the strength of the column is almost independent of the slenderness-ratio. But they also show that the results of the tests are not as uniform as they should be in a carefully conducted investigation. The writer believes that the irregularities in the results are due to a difference in the water content of the concrete, which, in turn, was due to the particular location of the column in the mold and to the location of the mold.

For example, Fig. 3 shows that the 30-in. columns were the strongest and the 60-in. columns the weakest of the entire group. If the mold shown in Fig. 2 sloped downward in the direction from the upper right to the lower left of the plan, the water which was worked out of the concrete flowed so that the 30-in. columns would contain the least water and the 60-in. columns the most; this would produce the differences in strength shown in the diagram. In the second group

FIG. 5. SHORT TEST COLUMN FRACTURED IN 6-IN. DIRECTION

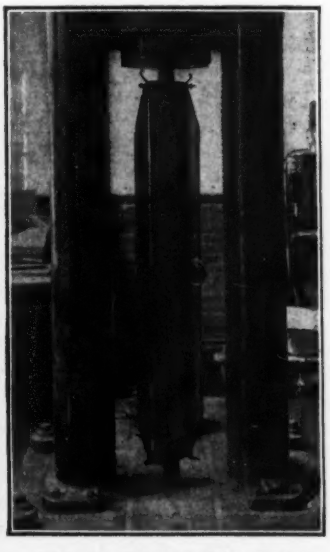


FIG. 6. ROUND-END TEST ARRANGEMENT
Two dials measured deflections

(Fig. 6) the two center columns, i.e., the 22½-in. and 52½-in. columns, were the strongest. If the mold was level and the concrete a little thicker in the center columns than in the side columns, the water worked out of the center columns would flow over the side columns and, as a result, the side columns would be weaker than the center columns.

Another interesting fact developed in the second series of tests was that the strength of the 6 x 12-in. check cylinders was in several cases somewhat lower than the strength of the slender, round-ended columns. This was probably due to the fact that the cylinders, being twice as deep as the columns, retained relatively a higher proportion of the mixing water, and therefore attained a lower strength.

Theoretical Length-Relation—Considering the column from a theoretical point of view, it is evident that

so long as the column does not bend, its strength is independent of its slenderness-ratio, and that after flexure has taken place, either due to non-homogeneity of the material or due to eccentric loading, the load which can be safely supported by the column will decrease as the flexure increases. Since the bending moment in the column at any point is proportional to the deflection at that point, and since the flexure of a bar can be determined by considering the moment diagram as the loading diagram and finding the resulting moment, it can be shown that the deflection of a long column is proportional to the square of its length.

Then the stress due to flexure also varies as l^2, and since Euler's formula gives the ultimate strength of a long column as $\frac{\pi^2 EI}{l^2}$, it is evident that Euler's formula can only be applicable in those cases where the stress due to flexure is infinitely great as compared with the direct stress due to the load. However, in the tests

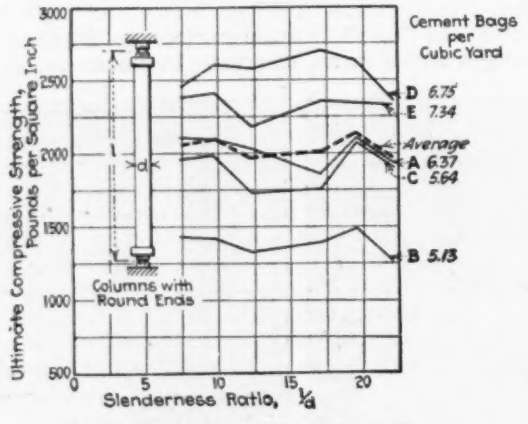


FIG. 7. ROUND-END TEST RESULTS
Each point of the full lines represents five columns; the dash line is the average of the five series.

reported above, measurement of the deflections by means of Wiesler dials (Fig. 6) showed a maximum deflection of only 0.013 in. This occurred in a round-end column 67 in. long, at a load about 90 per cent of the ultimate, at which time the deflectometers were removed. The stress due to flexure was therefore 59 lb. per square inch and the direct stress was 2,240 lb. per square inch.

In order that the two stresses might have been equal, the column would have had to deflect about ½ in., or about 38 times as much as it did.

It therefore seems clear that the stresses due to flexure in concrete columns will always be very much less than the direct stresses due to the loads and that therefore Euler's formula and the straight-line formulas based on Euler's cannot be correctly applied to concrete columns. The error due to their use is on the side of safety, however.

The columns of the first group were prepared and tested by G. A. Parkinson, assistant testing engineer. Those of the second group were prepared by F. L. Snodgrass, laboratory assistant, and tested by Mr. Snodgrass, Mr. Parkinson, and H. R. Thomas, testing engineer. The latter gave special attention to the testing of the long columns for which the deflections were determined.

Lime Treatment of Sewage Compared With Direct-Oxidation

Study of Easton Tests and Working and Experimental Results at Worcester with Lime Alone Against Electrolytic Method

BY ROY S. LANPHEAR
Supervising Chemist of Sewage-Works, Worcester, Mass.

THE "direct-oxidation" method of sewage treatment has not been generally accepted by sanitary engineers as satisfactory, either as regards efficiency or cost. Lime treatment of sewage at Worcester has been practiced for more than thirty years and has been studied from many angles. The results obtained both in every-day operation of the plant and in some recent experiments taken in conjunction with the Easton tests indicate that the "direct-oxidation" process gives no results of practical value not readily obtained at less expense by using an excess dose of lime alone.

"Direct-Oxidation" Tests at Easton, Pa.—Operating data concerning this method of sewage treatment are meager and usually represent comparatively short test periods of operation. This is unfortunate and makes the data of no real practical value. The results of the Easton, Pa., tests, given in *Engineering News-Record*, Sept. 18, 1919, p. 569, cover a number of tests, no one of which is longer than 24 hours. In this plant, the fresh, rather dilute domestic sewage passed through a coarse bar screen, centrifugal pump, flat plate screen with closely spaced ¼-in. round holes and a grit chamber. It was then treated with lime, passed through electrolytic cells, thence to settling reservoirs, giving 2½ hours detention when free from sludge. The result for the 24-hour test is summarized in Table I.

TABLE I.—EASTON "DIRECT-OXIDATION" TESTS COMPARED WITH WORCESTER WORKING RESULTS IN 1921 WITH LIME ONLY

	Raw Sewage		Effluent		Removal P. P. M.		Per Cent Removal	
	Easton	Worcester	Easton	Worcester	Easton	Worcester	Easton	Worcester
Total solids.....	217	615	640	497	—423	118	—194.9	19.2
Volatile solids...	114	285	94	207	20	78	17.5	27.4
Suspended solids	74	151	26	58	48	93	64.9	61.6
Free ammonia...	11.3	17.2	9.3	14.8	2	2.4	17.7	13.9
Organic nitrogen	34.5	4.9*	21.6	3.1*	12.9	1.8*	37.4	37.3*
Oxygen consumed	53	81.3	44	37.4	9	43.9	17.0	54.0

* Albuminoid ammonia instead of organic nitrogen is reported at Worcester

The bacterial content of four samples of sewage was from 48,000 to 1,200,000 per c.c., averaging 600,000; of effluent, from 54 to 30,000 per c.c., averaging 12,391. These four samples were stable.

In connection with these results, attention is particularly directed to the fact that the promoter set the rate of application of lime so that it was used at a rate of 3,720 lb. per million gallons of sewage treated. Lime addition was supposed to have been made only "to insure positive alkalinity" and "satisfactory operation required an alkalinity of 30 p.p.m." The total alkalinity of the screened sewage previous to the lime addition was about 90 p.p.m. and of the effluent, from 252 to 380 p.p.m. The effect of this excess alkalinity is not stated.

The Franklin Institute tests at Easton, summarized in the same article, do not give alkalinity or stability results, nor is the quantity of lime used per million gallons of sewage treated given, but Table V, p. 572 of the article cited, indicates that lime had a greater effect upon bacterial reduction than electrolytic treatment.

Chemical Precipitation at Worcester, Mass., 1921—The yearly average results of sewage treatment at Worcester during the year 1921 are summarized in Table I, for ready comparison with the Easton figures. The bacterial content of the effluent is variable, but is generally less than 50,000 per c.c.; the average stability is from one to two days and the average alkalinity less than 20 parts per million.

While the analyses of the two effluents are not strictly comparable on account of the period of operation, it appears that the chemical precipitation effluent is not of as good quality as that obtained at Easton. The quantity of lime used at Worcester averaged 538 lb. p.m.g. of sewage treated, or only about one-seventh of the quantity used at Easton. What would be the result of sewage treatment at Worcester if lime was used at the rate of 3,720 lb. p.m.g.? The results obtained at Easton are not enough better, except perhaps as to stability, to warrant the expense of using seven times as much lime. How was this perfect stability of effluent obtained? If it can be shown that chemical precipitation of sewage—a much stronger sewage—will give an effluent having perfect stability by using an equal or less quantity of lime, then the electrolytic treatment of sewage with costly patented machines will evidently be a needless operation and an unwise expenditure of money.

Lime Treatment of Chemical Precipitation Effluent—The study of Worcester now to be outlined was first intended as an investigation of the relation of organic content of the effluent to its stability. While the details of the first portion of the work are not strictly essential to the purpose of this paper, the results indicate possible similar effects of treatment of "direct-oxidation" effluent, if the exceedingly large quantity of lime had not been used. Briefly, it was demonstrated that the usual samples of effluent from chemical precipitation of sewage, when diluted after additional dosing with lime, had the stabilities shown in Table II.

TABLE II.—STABILITY OF DILUTED CHEMICAL PRECIPITATION EFFLUENT

Dilution of 1 to 1		Dilution of 1 to 2		Dilution of 1 to 3	
Alkalinity P.P.M.	Stability Per Cent	Alkalinity P.P.M.	Stability Per Cent	Alkalinity P.P.M.	Stability Per Cent
60 or more	99	30 or more	99	20 or more	99
40 to 60	80	20 to 30	87	10 to 20	80*
30 to 40	75	10 to 20	78	0 to 10	91*
20 to 30	55	0 to 10	58	.....	..
10 to 20	16 to 99	.....	..	.....	..

* Samples having low alkalinities and varying organic content affected the average results.

Alkalinity was determined using phenolphthalein in the cold form and stability tests were made at 20°C.

According to these results, if no allowance is made for the dissolved oxygen in the diluting water, the undiluted effluent should be perfectly stable if the alkalinity is about 80 to 120 p.p.m. The chemical character of the undiluted effluent was slightly stronger than that of the effluent at Easton (Table I); therefore, it would appear that a similar statement could be made concerning the alkalinity and stability of the undiluted "direct-oxidation" effluent. If this be demonstrated to be so, and bearing in mind the actual use of lime at Easton, there was a reckless and extravagant expenditure of money made for lime in connection with the "direct-oxidation" method.

Undiluted regular samples of effluent from the Worcester chemical precipitation plant, some of which were alkaline and some acid, were treated with milk of lime solution of known strength so as to make a set of three samples of increasing alkalinity. The first series of tests, covering a period of three weeks, gave results shown in Table III.

TABLE III.—STABILITY OF UNDILUTED LIME TREATED CHEMICAL PRECIPITATION EFFLUENT

—Alkalinity P.P.M.— Range	Average	Bacteria Per C.C.	Stability Per Cent
100–150	129.2	5,787	99
150–200	172.6	2,973	99
200–400	273.3	1,650	99

Every sample having 100 p.p.m. alkalinity was stable; a few samples having an alkalinity of from 51 to 93 p.p.m. had a percentage stability ranging from 37 to 99 and showed variation in results. Almost without exception every sample showed reduction in bacterial content with increased alkalinity, but there were single days with comparatively high counts which increased the average results above the usual result. For instance, the usual bacterial count of the samples having 100 to 150 p.p.m. alkalinity was from 1,000 to 4,000 per c.c.; 150 to 200 p.p.m. alkalinity, 200 to 1,200; 200 to 400 p.p.m. alkalinity, but little reduction of usual counts and large reductions of high counts. Perfect stability of sewage effluents, similar in character to those at Easton and Worcester, is readily obtained, but it is not possible to obtain a sterile effluent unless greater alkalinities than 350 p.p.m. are used.

The second series of tests of undiluted effluent were similar and covered alkalinity ranges of 50 to 75, 75 to 100 and 100 to 150 p.p.m. The samples having at least 100 p.p.m. alkalinity averaged 123.3 p.p.m., the bacterial count averaged 8,630 per c.c. and all samples but one were perfectly stable, that one having 90 per cent stability. Samples having less than 100 p.p.m. alkalinity generally showed increased stability and decrease of bacterial content with increasing alkalinity, but the improvement was variable and very slight, especially when the alkalinity was less than 75 parts per million.

Lime Requirement for Stable Effluent—The usual daily quantity of lime used at Worcester at this time was 7½ tons, averaging 449 lb. p.m.g. of sewage treated. Increased alkalinities were produced at a rate of from 50 to 60 p.p.m. by using 500 lb. p.m.g., indicating an additional lime requirement for a stable effluent of about 750 lb. p.m.g., or a total of 1,200 lb. The average sewage flow was 26 m.g.d., requiring an additional quantity of 10 tons of lime, a total of 17½ tons per day. The cost of the necessary additional lime to produce a stable effluent would be $143 per day, lime costing $14.30 per ton, or $5.50 per million gallons.

Conclusions—A sewage, noted for its trade-waste content, and much stronger than that at Easton, can be treated with lime at a rate of about 1,200 lb. p.m.g. and a stable effluent obtained. Why use 3,720 lb. as at Easton?

The results of the Worcester experimental work indicate that the stable effluent, having excessive alkalinity, obtained at Easton by using this large quantity of lime, was probably due to the use of excessive quantities of lime rather than to the electrical treatment of the sewage.

It has been shown that an effluent from chemical precipitation having 100 p.p.m., or more, of alkalinity was perfectly stable; this being regularly obtained only when the alkalinity was at least 100 p.p.m. The char-

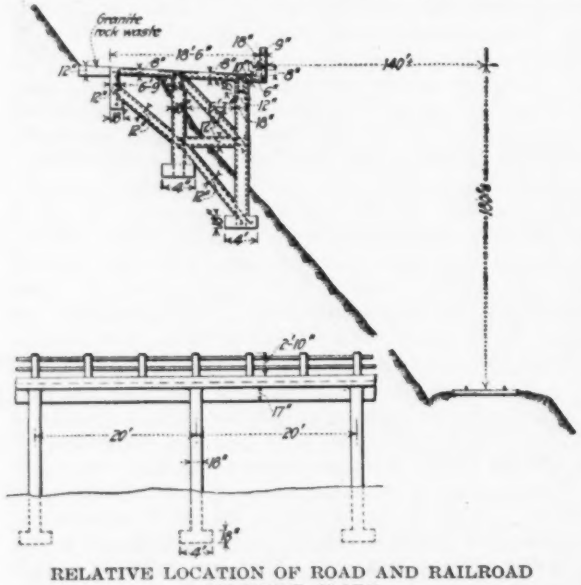
acter of the sewage treated was nearly twice as strong and the effluent was slightly stronger in organic content than at Easton; it would appear that an effluent from lime treatment at Easton, having from 252 to 380 p.p.m. alkalinity, should be stable without the use of electric current.

The lime-electrolytic or "direct-oxidation" method of sewage treatment must take an effluent from lime treatment, of approximately the character of Worcester or Easton effluent, having an alkalinity of about 30 p.p.m. (necessary for method) and a probable stability of from 20 to 30 per cent and obtain a perfectly stable effluent by electrical treatment. Otherwise sewage treatment by electric current can not be seriously considered. Further, since the use of additional lime gives a perfectly stable effluent, it is necessary that the cost of electrical treatment of sewage be less than that of the additional lime.

Sidehill Viaducts Carry Highway in Canyon Above Railroad

Slopes as Steep as ½ to 1 Between Highway and Railroad Made Material Handling a Problem on California Job

IN LOCATING the new highway from Santa Cruz, Cal., to the "Big Trees" it was found possible to reduce greatly the distance if a route paralleling the Southern Pacific R.R. through a narrow canyon could be followed. This route was selected and by using care in the design and location of the necessary sidehill structures, as well as means of handling material, the



RELATIVE LOCATION OF ROAD AND RAILROAD ON STEEP SLOPE

Where these sidehill structures were built, excavated material could not be dumped over the bank on account of the track below.

work was completed with practically no interruption to train schedules. The slope on which the roadway and railroad are located is as steep as one-half to one in many places and a fair average for several miles is one to one. The new highway is four miles long and is to be paved for its entire length. The major portion of the work was done last fall.

Through the sections where construction was most difficult the line skirts the side of the canyon from 100 to 180 ft. above the railroad with a horizontal separation of only 50 to 75 ft. In this portion of the road there are sixteen concrete retaining walls ranging up to 23 ft. in height and four sidehill viaducts. The latter have their outer edges supported by bents sometimes as much as 20 ft. high, while the inner edges are buried in the steep slope of the bank.

In the section where the chief problems were met, the slope of the sidehill averaged about three-quarters to one. In loose material whose stability and angle of repose are uncertain when moisture is in the ground, the final location had to be studied very carefully on paper and in the field before decision could be made as to comparative costs of the alternative methods of construction. The disposal of excavated material was a major problem, but excessive haul was avoided by making a careful study of the slopes below the roadway and utilizing to a maximum all depressions or pockets in which material would stand without danger of sliding down onto the track.

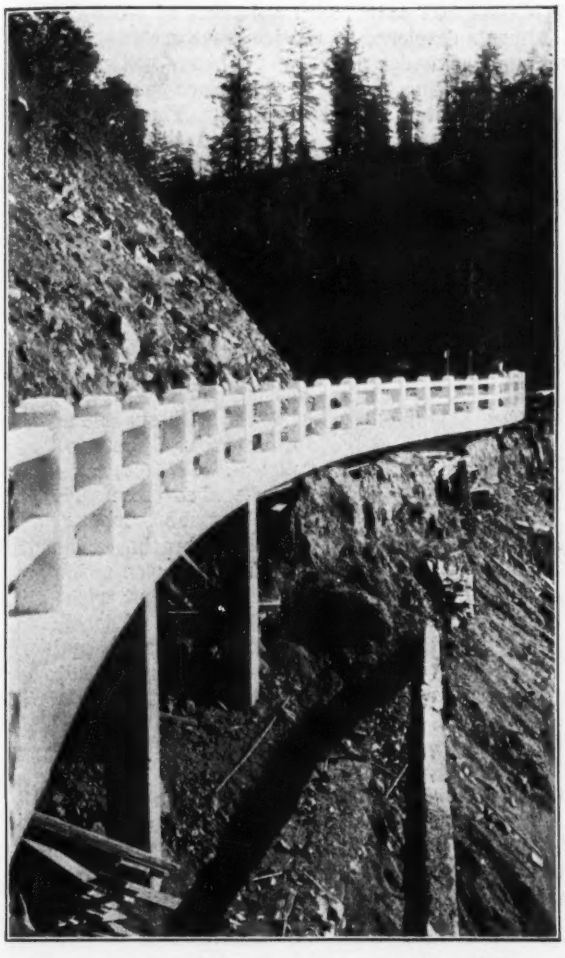
Where the roadway curved around slight depressions in the sidehill the subgrade was held in place by retaining walls resembling arch dams. Because of the convenience and probable low maintenance cost of this type of construction the location was shifted to favor the retaining wall in place of the sidehill viaduct wherever feasible. The retaining walls also had the advantage that material filled in behind them helped to reduce overhaul. Both the cantilever and buttress types of retaining walls were used according to conditions. Retaining walls as well as sidehill viaducts were heavily reinforced, ½-, ⅝- and 1-in. bars being used.

The sidehill viaducts are located at points where no simpler types of construction seemed feasible. In working out detailed designs for these structures primary consideration was given to proper drainage. Because the material traversed is largely disintegrated granite and other porous material, tile drains or similar methods of unwatering the slopes above the road were not used and endeavor was concentrated on preventing seepage water or water coming down the slopes from getting under the structures where it might soften and undermine the supports.

Along the hillside or inside edge of the structure an excavation was made into which Logan waste, the product of a local granite quarry which packs in an impervious layer, was placed to form a water seal. This material was placed in a layer about 14 in. thick and extended into the bank about 6 ft. from the edge of the pavement. When the concrete roadway was poured it was embedded in this seal so that surface water coming down the steep slope or out of the cut would be diverted upon the pavement. As the roadway is nowhere without at least a slight grade, the surface water is readily retained by a curb along the outer edge terminating at suitable points in culvert discharges.

The longest sidehill viaduct is 160 ft. in length and involves a reverse curve. One expansion joint was put in the pavement about midway of this structure. No joints were used in the other sidehill viaducts, however, several of which also contain reverse curves. No effects of expansion and contraction appeared during the winter months that followed the completion of these structures and close observation will be made to see whether any

develop during the coming summer. In the railings where expansion joints were put in every 40 ft., considerable movement due to temperature changes has already been noted. These joints are located in the posts and consist of tar filler between the abutting ends of the concrete rails. The strength of the railing



SIDEHILL VIADUCT ON HIGHWAY ALONG STEEP CANON WALL

Railing was cast monolithic in place. Footings protected against seepage by seal on inner edge of pavement.

at these points is retained by a dowel consisting of a ¾-in. smooth reinforcing rod partly embedded in one rail and projecting from the rail-end into a 1-in. pipe socket embedded in the concrete of the abutting rail.

The pavement is 5 in. thick where it is laid on the ground and this is increased to 8 in. where the sidehill viaducts are used. The mix was 1:2:4. The roadway width is 16 ft. with an increase of 2 ft. on curves of less than 200-ft. radius. Due to probable line changes and the desire to allow fills to settle, the pavement could not be laid continuously, and about eight "exceptions" or gaps were left unpaved. In anticipation of heavy traffic before these gaps could be completed and to prevent breaks at the ends of the concrete slabs, each slab end was thickened as a protection against impact. The thickening was begun 6 ft. back from the end of the slab and uniformly increased to a thickness of 12 in. at the ends.

As was expected, some material slid onto the roadway from above during the winter but this was not of serious extent and except in a few cases where heavy boulders smashed through the railing or cracked the outer edge of the pavement slab, the concrete structures were not damaged.

Lloyd Bowman, county surveyor of Santa Cruz County, had charge of design and construction on the work described in the foregoing.

Wrought Iron From an Old Chicago Bridge

EXAMINATION of the wrought iron from the old (and now dismantled) Rush St. drawbridge over the Chicago River, made an interesting showing of the character of structural metal used when that bridge was built, in 1884. The builders were Rust & Collidge. This examination was made by C. A. Akerlind, machinery inspector, who reported to Thomas G. Pihlfeldt, engineer of bridges for the City of Chicago.

Tensile tests on two samples from the web of a 10-in. channel gave the following results, the lower elongation in the second piece being due apparently to a crystalline spot.

Elastic limit	33,050 lb.	34,180 lb.
Ult. tensile strength	49,950 lb.	49,300 lb.
Elongation in 8 in.	22 per cent	15 per cent

Etching tests were made on specimens cut from truss rods and eyebars, and the report on these is as follows:

The 1⅜-in. truss-rod specimens are particularly interesting as they show clearly that the bar is built up of muck bars and therefore is real new wrought iron. The 1¼-in. specimen makes a rather prettier showing, but the bloom from which this bar was rolled was made up of scrap iron. This is not necessarily detrimental to the quality of the iron if the scrap is selected and properly placed before welding and rolling, or forging. In those days scrap iron was always wrought iron, while now so-called "wrought-iron" manufactured, for example, in the neighborhood of Chicago, is welded up soft steel, the product being what is technically known as "bushel iron." At these mills wrought iron scrap is bought, like boiler tubes, old horse shoes and old freight car axles, but this material is getting more scarce and is used only for special purposes.

The 5 x 1-in. eyebar specimen shows the bar to have been rolled from a pile of muck bars, all new wrought iron. A small specimen cut from one of the broken test pieces of the channel iron indicates clearly that that channel was rolled from a bloom made up of scrap iron. This particular piece offered greater resistance to the acid than any of the others, indicating that some of the scrap used had consisted of "refined" or even "double refined" wrought iron. I have had cases of double refined wrought iron for locomotive boiler stay-bolts that resisted the action of the etching fluid for hours, while the more open iron would be affected in a few minutes. The 5 x 1-in. specimen indicates clearly the different qualities in the material to resist corrosion.

Railways in China

The railway system of China at the end of 1920 aggregated 6,805 miles, according to the report of the Ministry of Communications. This included 3,980 miles of government lines and 480 miles of provincial and private lines, making 4,460 miles under the control of the Ministry of Communications. The remaining 2,345 miles consist of five concession railways. Exclusive of the dependencies of Mongolia, Turkestan and Thibet, the country has 276 square miles of territory and a population of 54,000 per mile of railway, as compared with 16 and 8,000 for Japan and 12 and 3,800 for the United States.

Liverpool to Undertake Harbor Extension

An important extension of the Liverpool dock system has been decided upon by the Mersey Dock and Harbor Board, at an estimated cost of $1,988,301 (pounds sterling converted at par). The scheme is to arrange for the closing of the existing river entrance to the Gladstone dry dock, and for inclosing the dock so that it shall form part of a system to be known as the Gladstone System of Docks. This system will include two new wet docks now in the course of construction. The scheme, according to the chairman of the works committee of the dock board, includes the building of a new entrance 1,070 ft. long between the inner and outer pairs of gates, with a width of 130 ft. and a sill below bay datum of 20 ft., which will provide a depth of 21 ft. 4 in. at low-water ordinary spring tides and 41 ft. 7 in. at high-water ordinary neap tides. Steamers using the Gladstone dock will be able to proceed directly to a graving-dock without having to pass out into the river, and entrance to the new system will not be so exposed to the weather as the present entrance to the dry docks. The largest ships will be able to enter and leave on every tide of the year, and ships of ordinary size will be able to do so at any time of any day, except for a few hours each side of low water on the spring tides. It is anticipated that the entire scheme will be completed in two years.—*Commerce Reports.*

Public Health Courses and Degrees at M. I. T.

Although the Harvard-Technology School of Public Health no longer exists, there will continue to be interchange of facilities between the two institutions, according to an announcement just issued by the Department of Biology and Public Health of the Massachusetts Institute of Technology, signed by Prof. S. C. Prescott, head of the department. Students in the department may be candidates for the degree of Bachelor of Science, Master of Science, Doctor of Philosophy, or Doctor of Science in Public Health, or for a Certificate of Public Health. Women are accepted as candidates for degrees.

Simple Plant for Laying Large Diameter Pipe

Hook on Ditcher Boom Rips Out Concrete Pavement —Steel Fingers Fit Pipe Ends Together— Bonus Increases Output

A COMPACT outfit, with a number of unique attachments developed on the job, gave excellent progress last summer, under the urge of a bonus-system of wage paying, in laying 72-in. and 84-in. lock-bar pipe for the Torresdale filters in Philadelphia. The outfit, as it approached the finish of the operation, is shown by Fig. 3. Except the wheelbarrow gang, this is not a posed situation of the plant units, but is a fair representation of average close-working due to one crew crowding another in an effort to earn bonus wages.

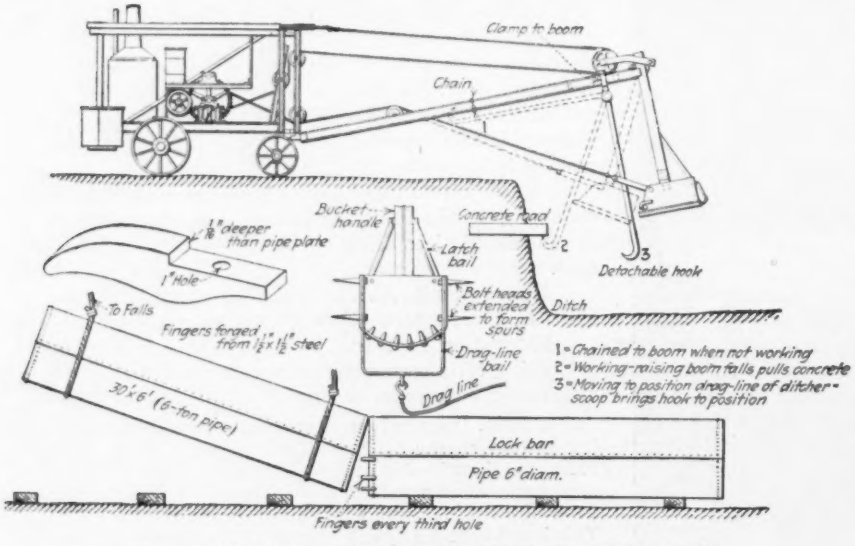


FIG. 1. JOB-MADE ATTACHMENTS EXPEDITE PIPE-LAYING

An 8-ft. trench, 10 ft. deep was dug for the pipe, 100 ft. of 84-in., with six connections for centrifugal pumps, and 2,600 ft. of 72-in., all set in a cradle of concrete. The soil was a wet sandy loam calling for strong bracing and much pumping. Close sheeting was not necessary, but without it fast work was advisable. A Keystone excavator, equipped with its standard ditcher bucket and handle attachment, dug the ditch, loading into dump wagons which returned the soil to the rear for backfilling. The only drawback to plain digging was the unexpected disinterment, about 18 in. below the surface, of an old concrete pavement as indicated in Fig. 2. To handle this and the wide trench sides, attachments to the excavator, Fig. 1, (detail sketches) were devised by Frank B. Lee, superintendent for the

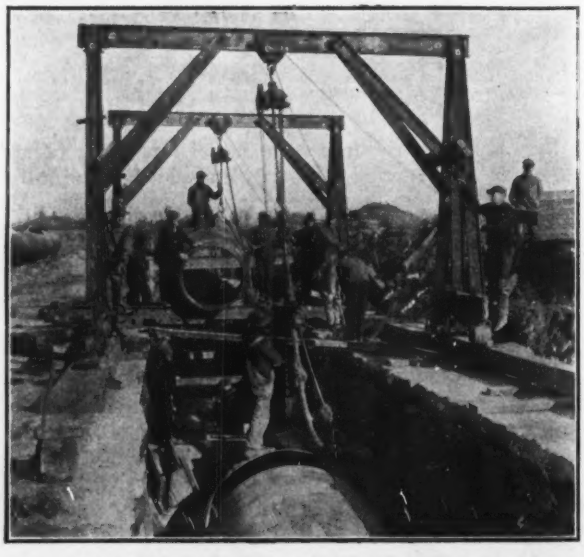


FIG. 2. GANTRY OUTFIT LOWERING SIX-TON PIPE

contractors. A hook hinged to the boom, as indicated by the sketch tore up the old pavement. To cut the ditch sides, spurs were put on the bucket by lengthening and sharpening the heads of the bail bolts. By swinging the bucket and lifting and lowering the boom the trench sides were scored and broken down vertically.

Each 72-in. pipe weighed 6 tons and, as shown by Fig. 2, was handled into the trench with two gantrys. These were made of steel shapes and put on rollers with extended square hubs. Using wrenches on the hubs, four men were able to shift the gantry along the trench to adjust precisely the two pipes being joined. Another aid that was employed, with the most satisfactory results, was the jointing fingers indicated by Fig. 1.

The pipes were laid on six-inch square timbers

FIG. 3. THREE-UNIT OUTFIT FOR LAYING 6-FT. STEEL PIPE

and as the concrete mixer came along were filled underneath and up the sides with concrete.

All construction was performed with a bonus system of payment in force. For each operation, trenching, pipelaying and concreting, a stint was set. For example, in pipelaying, three pipes in place made a day's work. If another pipe was put in each man got a dollar. In excavating, 50 ft. of trench was the stint established and for every additional foot each man got 50c. Sometimes five and six pipes a day were laid and 60 ft. of trench were opened. A feature of the bonus payment was that the men got each day's extra wage the day that they earned it, which appeared to be particularly pleasing to them; it was money they "did not have to account for in the Saturday pay-envelope."

The work as described was performed by the Beam-Craven Co., Philadelphia, Pa., for the Philadelphia water department.

Large Caisson for a Dry Dock

A pneumatic caisson 1,130 x 197 ft. weighing about 8,000 tons is to form the foundation of a new dry dock at Havre, France. Its framing will comprise six longitudinal trusses 21 ft. deep and 40 transverse trusses. The dock will be 1,024 x 174 ft., accommodating vessels of 100,000 tons displacement and with a draft of 44½ ft.

Unique Water-Works for Nabaclis, British Guiana

THE water-works of Nabaclis, British Guiana, includes an artesian well, an iron-removal plant, water mains and hand pumps. The working head without the pumps is 7 ft., of which 4 ft. is afforded by the artesian pressure and 3 ft. by laying the mains at that depth below the ground surface. The foregoing and the following facts are taken from *Public Health Engineering Abstracts* (U. S. P. H. S., Washington, D. C., July 29), which in turn gives credit to an article by Dr. E. P. Minett, medical officer of health, British Guiana, in *Transactions* Royal Society Medicine and Hygiene, Feb. 16, 1922.

The well is 600 ft. deep and has an 8-in. casing. The water before treatment contains much iron in the ferrous state (see table herewith) and has a temperature of 95° F. The country is flat. The aerator, filter, distributing mains and hand pumps are thus described in the *Abstracts:*

At the well the part of the casing extending above ground is perforated, the water flowing onto two trays having baffle boards and stones to aerate the water. The water then flows down a shoot having baffle boards on the staggered plan containing stones, to further break up and aerate the water. From the shoot, the water flows onto a flat concrete table with ½-in. holes; then to a layer of stones, gravel and fine sand underneath which removes the precipitated iron; then to a concrete and iron storage tank; then to 6-in. mains tothe village. The water is pumped from the mains by hand pumps on concrete slabs, the pumps being tied onto the mains direct and placed at suitable points in the village. To avoid pitting of the iron pipes, the whole of the 6-in. mains were lined with bitumen. It is necessary to clean the sand filters every three months, this being done by reversing the flow by special pipe arrangement.

WATER AT NABACLIS BEFORE AND AFTER TREATMENT
Government analyses on Dec. 9, 1921. Parts per 100,000 except last two items.

	Water flowing From Casing	Water Aerated and Filtered as Delivered From Main
Iron	.56	Nil.
Calcium	.55	1.09
Magnesium	.56	.78
Sodium with traces of potassium	2.67	1.51
Chlorine	1.84	1.84
Sulphate ion	.06	trace
Nitrous ion	.007	.003
Silicate ion	.95	1.27
Carbonate ion	3.96	2.61
	11.157	9.103
Oxygen absorbed from acid potassium permanganate at 82 deg. F.		
In 3 minutes	.08	Nil
In 4 hours	.15	.25
Free Ammonia	less than .001	less than .001
Albuminoid ammonia	less than .001	less than .001
Nitrogen in nitrites	.002	.001
Dissolved oxygen, per cent of possible	58.2	87.4
Relative proportion of free carbonic acid in solution	100	33

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Modern Tunneling Enlarged

MODERN TUNNELING—By David W. Brunton and John A. Davis. New Chapters on Railroad Tunneling by J. Vipond Davies. Second Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall. Cloth; 6 x 9 in.; pp. 612; illustrated. $6.50 (39s. net).

In this re-edition of a work first published at the beginning of the war, virtually two books are offered to the reader, the original treatise on mine and water-supply tunnels by Brunton and Davis and a book of 150 pages on other types of tunnel by J. Vipond Davies. Mr. Davies' competence for the task of dealing with this subject, including compressed air and shield work, is so thoroughly known that it gives the reader full guarantee for the character of the information offered to him here.

The new section is placed under the broad title "Railroad Tunnels," but it is much more comprehensive than its title, as it deals with all kinds of tunnel other than mining and water-supply tunnels. This is a field broad enough to claim the space of a large treatise, and, as it is compressed into 150 pages, the author necessarily proceeds with extreme brevity and condensation. The matter on general considerations: location, type of work, lining, and other features of design, is therefore not very detailed, but it is sufficient to give the reader a satisfactory general posting on the preliminary decisions to be made in undertaking a tunnel.

Under the heading "Construction" a marked simplification of discussion is achieved by eliminating all the so-called European systems of tunneling. The author, in fact, implies that they have lost their former importance rather completely: "The far simpler American system has been thoroughly proved in rock and in soft ground tunnels for many years, under nearly every kind of condition with complete success, and any engineer who is thoroughly conversant with the basic principles and with the possible modifications of this system has enough theoretical knowledge, at least, for this phase of any tunnel problem—other than shield driven—that may be presented." This conclusion permits of confining the treatment to the types of tunnel construction familiar in American practice, which constitutes one of the essential differences between the present work and Drinker's early treatise, for example.

The detail treatment then is worked out on the basis of making the book one of general posting and information as to methods and reasons for choice between different methods rather than a working handbook presenting data of various kinds, although the author includes many numerical data, in the aggregate. The author deals first with surveys and plant—properly giving special consideration to loading and hauling provisions—and then goes in detail into the excavation methods applicable to a hard-rock tunnel. Heading and bench arrangement, drill-hole layout, and the like are carefully summarized. Following a chapter on loose rock and soft ground tunnels, in which arch-set and related timbering forms are covered, subaqueous tunnels are taken up. Shield tunneling is here discussed in a most illuminating and clear way, though details such as shield design are not entered into. In conclusion, the caisson, cofferdam, and trench systems of tunnel construction are briefly treated.

In the book as a whole the reader has before him a full and modern compilation of information on tunneling procedure. Tunneling literature has been scant and unsatisfactory for many years, and foreign books have failed to meet the needs of the American constructor. In the present enlarged work a handy compendium of the general outlines of procedure is available that should fit working needs very closely.

An American Who's Who Among Engineers

WHO'S WHO IN ENGINEERING: A Biographical Dictionary of Contemporaries, 1922-1923—By John William Leonard. Brooklyn Borough, New York City: John W. Leonard Corporation. Cloth; 6 x 10 in.; pp. 1509. $10.

Members of the engineering profession, employers of engineers, the technical and daily press and many others as well have reason to be thankful for the publication of this engineer's Who's Who.

It contains sketches of 10,494 engineers along somewhat the same line as the well-known general Who's Who published in this and other countries, but with detailed extensions along professional lines that would not be feasible in a general Who's Who. An improvement in the arrangement of this compared with the general Who's Who is the giving of the name, business and residential addresses in a separate paragraph at the head of the sketch. The volume contains a geographical index of names.

Some of the professional records are quite detailed; others are much condensed. The variations evidently accord in many instances with the facts while in others they presumably reflect the human equations of the subjects of the sketches. Taking into account the uses to which the volume will doubtless be put, the details are as a rule well justified. They should be regarded as statements of fact rather than exhibitions of personal vanity. Considerable abridgements, by more use of summaries, may be required here and there as the volume grows in the number of engineers represented.

That this Who's Who will grow by the addition of many names seems beyond doubt, for it takes only a brief examination of the book to show that numbers of our leading engineers are conspicuous by their absence. Responsibility for this—we conclude from the Introduction and from our own inquiries and deductions—is due far less to the publisher than to the omitted engineers themselves, who through false modesty, oversight, neglect, or suspicion failed to supply the information they were asked to give.

That there should have been mistrust as to the motive of the publisher is not surprising in view of the fact that this is the first American "Who's Who in Engineering" and that there have been many ventures in the Who's Who and similar lines that were mere catch penny or catch sucker affairs. The ear mark of such ventures is a more or less veiled, or wholly barefaced intimation that the inclusion of your sketch depends

upon the purchase of one or more copies of the volume in which it is to be included. Contrariwise, the ear mark of the *bona fide* Who's Who is assurance, with the questionnaire, that filling in the latter does not in any way obligate the subject of the sketch. Such an assurance was given in connection with the present volume.

The publisher announces that the work will appear biennially, so in due time there will be an opportunity for those whose names really should be found in this useful work to ensure their appearance in the issue scheduled for May, 1924.

A Compendium of Highway Progress

HIGHWAYS GREEN BOOK (Third Annual Edition, 1922). Edited by M. O. Eldridge, Director of Roads, A. A. A. Good Roads Board, and published by the American Automobile Association, Washington, D. C. Cloth; 6 x 9 in.; pp. 429, illustrated. $3—$2 to A. A. A. members.

So rapid are the changes which are taking place in the field of American highway development that a summing up of each year's progress is needed to enable engineers and others concerned with good roads to orient themselves with respect to the new conditions. For several years, through the medium of its Highways Green Book, the Good Roads Board of the American Automobile Association has been performing this service. For those familiar with the publication it is enough to say that the third annual edition for 1922, just published, maintains the high standard of previous editions, follows the general arrangement of material formerly employed and brings the information up to date. Forming a compendium of the outstanding road-building activities of the year 1921, the volume contains a fund of interesting and informative data not only for highway engineer and contractor but for public speaker, legislator, journalist, manufacturer, motorist and citizen at large.

The book of 429 pages is divided into three parts, the first dealing with road improvement under federal, state and local control; the second with highway construction and maintenance; and the third with miscellaneous information, including such subjects as highway financing and taxation, automobile registration in 1921, highway research and transport economics. The chapters on all of the topics which are not essentially of a statistical nature have been prepared by selected specialists. The general situation on present and future prospects are summed up by Senator Charles E. Townsend, Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads and Charles M. Babcock, president of the American Association of State Highway Officials. The Federal Highway Act of 1921, creating an interstate system of highways, is reproduced in full and is followed by a detailed statement for each of the 48 states covering highway management and financing, together with a summary of local road and bond legislation. This portion of the book is exceedingly useful for reference purposes.

In Part II the chapters relating to the several standard types of highway construction appearing in former editions have been revised or entirely rewritten to bring the information up to date. This year the chapters on earth and macadam roads have been omitted and attention has been centered on the more durable types, beginning with sand-clay and gravel roads and ending with granite block.

Much new material is contained in Part III, "Miscellaneous." The increased interest in road transport economics is reflected in a number of articles on highway research, load restrictions, tractive resistance and similar topics. Of particular interest is the section on highway financing and taxation which lists, by states, the source and approximate amount of state highway funds available, exclusive of federal and county funds, and also a tabulation of state and county highway bond issues from Jan. 1, 1919, to Dec. 31, 1921.

In presenting a comprehensive picture of today's highway activities and in supplying a fund of valuable reference data, particularly on legislation, finances, design, and construction, the Green Book renders a real service. A nice discrimination has been exercised in the selection of material and in the manner of its presentation with the result that the volume makes interesting reading, covering the outstanding subjects adequately yet without getting into the detail which would make the text tedious except to the specialist. Produced under the editorship of M. O. Eldridge, director of roads for the A. A. A. and for many years on the engineering staff of the U. S. Bureau of Public Roads, the book testifies to a full understanding on the part of its maker of the economic, financial and engineering problems that today enter into the construction of highways.

Industrial and Social Problems

HUMAN FACTORS IN INDUSTRY: A Study of Group Organization—By Harry Tipper. New York: Ronald Press Co. Cloth; 5 x 8 in.; pp. 280. $2.

To the man not fond of abstract ideas but keen for light on the fundamentals of the industrial and social problems of the day this book will be helpful. "It is hoped," says the author in his preface, that the book "will present to the busy man and the student of industrial affairs a sufficiently complete and concise analysis of the difficulties which must be met and the outlook in meeting them." This hope has been fulfilled.

Mr. Tipper aims, he tells us, to confine himself to "the practical development of industry in the more or less immediate future." This does not preclude sketching the rise of the labor unions and analyzing the idea out of which they have grown. He relates our social and economic problems to the complications of modern life that have grown out of our rapid scientific and industrial progress. He points out the folly of any scheme of industrial organization based upon the assumption of a continuous state of warfare between two or more of the producing groups and presents in detail some of the plans that have been devised and are being tried to establish greater community of interest. In his final chapter, The Outlook, Mr. Tipper declares that the problems now before industry call for a new brand of leadership. The next generation, he believes, will determine by the intelligence of its leadership, whether the development of our industrial structure will be directed by the collectivists or whether a way out will be found that will conform to the requirements of individual human growth.

Further indication of the scope of Mr. Tipper's book is contained in some of the chapter-titles. One deals with Manufacturers' Organizations, another with Collective Bargaining, and a third with Experiments with Employee Representation. The use of labor-union machinery as a means for procuring industrial harmony and the open shop are discussed in still other chapters. These few subjects, selected at random, will suggest how concretely the author has presented his subject.

Accounting for Contractors

PRACTICAL ACCOUNTING FOR GENERAL CONTRACTORS—By H. D. Grant, Staff of W. B. Richards & Co., Accountants and Engineers, etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 254. $3.

Accounting for contractors has generally been discussed in books and articles with the purpose of presenting simple methods which the contractor could himself learn and apply. In this volume the author has assumed that accounting in construction operations is no more a task for the works manager and executive than it is in any other business but is one to be performed by accountants. The book is, therefore, written for the accountant. It is not abstruse or super-technical but it assumes familiarity with book-keeping terms and processes. The author claims that the book presents certain methods of recording construction operations not previously formulated into a complete system.

Divided into three parts, the book first discusses accounting as related to types of contracts; purchases; recording income and expenses, and rendering financial statements in such number and of such character that the executive management may know at all times exactly the financial conditions and prospects of the business. Field accounting is covered in the second part. This is the part which the works manager will perhaps appreciate most and understand best since it deals with expense classifications, costs, and reports to the owner. The third considers payroll problems, control of equipment, preparation of estimates and bids, municipal contracts and the legal aspects of contracts. An appendix gives drafts of several forms of contracts.

Organizations, diagrams, sample pages of accounts, report and order blanks and item schedules, illustrate the text. There is a satisfactory index.

Purchasing

THE SCIENCE OF PURCHASING—By Helen Hysell. With an Introduction by J. George Frederick, Author of "Modern Salesmanagement." New York: D. Appleton & Co. Cloth; 5 x 8 in.; illustrated. $2.50.

So much has been written on the strategy and tactics of the commercial offensive, that is to say, the science and art of salesmanship, that one picks up this book with the feeling that here at last he is to have revealed to him something of the strategy and tactics of defense. He will not be disappointed. It will be found in the chapter entitled: "Attitude Towards Sales Solicitation." The book, however, contains much more than this. It is an effort to formulate the science of purchasing and takes into account every phase of that work. Development of principles and policies, the study of future trends and forecasts, the records and systems of the organized purchasing department and the ethics of modern business all find a place. The engineer in general will be interested in this application of scientific principles to still another department of business. If, as part of his work, he must conduct large-scale purchasing operations he will find the book helpful and suggestive.

British Building Operations

BUILDING CONTRACTS: The Principles and Practice of Their Administration—By Edwin J. Evans. Foreword by Sir Charles T. Ruthen, O.B.E., F.R.I.B.A., H.M. Director-General of Housing, and President of the Society of Architects. [The Directly-Useful (D. U.) Technical Series.] New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 304.

Building in England is different enough in most of its trade practices from building in America to lend interest to this manual for British builders. In addition the author has a gossipy, readable style with a homely attraction, particularly suitable as a manner of addressing the building trades contractor and foreman. Its detail is the especial claim of the book to usefulness. It takes up the various building operations in order, first the direction of construction, then office management, and finally book-keeping, and goes into every minute detail to be observed and every possible trouble to be anticipated and guarded against. Most of the items considered enter into building practice everywhere, so the advice and the suggestions offered will assist the American building contractor as much as his British brother in business. The American builder will not find in the book specific practices which he can apply in his own operations but he can draw from it a wealth of practical advice on the management of a building construction business.

New Edition of Wegmann's Dams

THE DESIGN AND CONSTRUCTION OF DAMS: Including Masonry, Earth, Rock-Fill Timber, and Steel Structures; also The Principal Types of Movable Dams—By Edward Wegmann, C.E., M. Am. Soc. C. E., M. Am. Water-Works Assoc. Seventh Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth, 9 x 12; illustrated; pp. 555. $10 (50s. net).

Wegmann's "Dams" is too well known to require an extended notice of this new edition. In so far as gravity section masonry dams go its theory is complete and satisfactory, though in the newer types of dam there is much left to be desired. Its strong point, however, is the record of existing structures, for, with all the progress in design, dam building continues to be somewhat empiric. The new edition differs from the old mainly in additional chapters on crest gates and siphon spillways and some description of later structures, but the revision has been something less than thorough.

For instance, both in the preface and in a table the Camarasa Dam in Spain is given as the "highest masonry dam in the world," while on another page the given dimensions of Arrowrock Dam show that structure to be higher. Both Arrowrock and Elephant Butte dams, described in the body of the volume, are omitted from the table of high masonry dams. Standley Lake dam, built in 1911, is described; its slips, both in 1914 and in 1916, matters of much greater importance to engineers than its design, are not mentioned at all. Nor is anything said about the Austin, Penn., and Stoney Creek failures, both most important to any one studying dam design.

These examples, which might be added to, are mentioned merely because the book is offered as a revision. What is old is still good but what is new does not seem to be complete.

Port Series Continued

THE PORT OF BOSTON, MASSACHUSETTS—[Port Series No. 2.] Prepared by the Board of Engineers for Rivers and Harbors, War Department, in co-operation with the Bureau of Research, United States Shipping Board. Washington, D. C. Paper; 6 x 9 in.; pp. 161; folding maps and tables.

The War Department and the Shipping Board are co-operating, through their engineers, in the complete study of the major ports of the country and as a part of the work are issuing descriptions and statistics of some 35 ports. The volume on Portland, Me., was published some months ago and now comes Boston. Nothing of interest in connection with the port is omitted. As records these books are invaluable.

Grain and Other Dust Explosions

DUST EXPLOSIONS: Theory and Nature of Phenomena, Causes and Methods of Prevention—By David J. Price, Engineer in Charge, Dust Explosion Investigations, Bureau of Chemistry, United States Department of Agriculture, M.N.F.P.A., and Harold H. Brown, Ph.D., Organic and Physical Chemist [as above], M.N.F.P.A., Assisted by Hylton R. Brown and Harry E. Roethe, Assistant Engineers in Dust Explosions [as above]. Published by Permission of the United States Department of Agriculture. Boston, Mass.: National Fire Protection Association. Cloth; 6 x 9 in.; pp. 246; 43 half-tones and line cuts. $3.

Grain elevator explosions are common enough to fix the dangerous inflammability and explosibility of grain dust in the mind of every designer and operator of such plants. It is not so well known that all manner of dust is subject to the same hazard and that any process that confines dust, of whatever sort, is a danger. This book, which bears every evidence of being the most elaborate study of the subject ever made, lists explosions in flour mills, grain elevators, feed and cereal mills, starch factories, rice factories, breweries (malt dust), and sugar mills as major instances, with aluminum, celluloid, cork, cocoa, cotton, fertilizer, powdered milk, phonograph records, rubber, shoddy, soap, spice, sulphur, seeds, etc., as further sources of danger.

The book describes the nature and theory of dust explosions, records the industries producing dust, explains the causes of explosions and finally details methods of design and operation whereby explosions may be avoided. It is a useful and authoritative work.

Engineering Publicity

PUBLICITY METHODS FOR ENGINEERS: A Manual for Men Engaged in Public Information Work—Proceedings of the First National Conference on Public Information Held Under the Auspices of the American Association of Engineers, 63 East Adams St., Chicago. Cloth; 5 x 8 in.; pp. 186; illustrated. $1.50.

Here are summarized the principles that govern the presentation to the public of information concerning the activities of engineers, together with examples. Among the contributors are Ivy L. Lee, advisor in public relations to the Pennsylvania Railroad; Richard H. Waldo, publisher, Hearst's International; J. G. D. Mack, state chief engineer of Wisconsin; F. H. Newell, the first director of the U. S. Reclamation Service; F. M. Feiker, vice-president, McGraw-Hill Co.; Alexander Black, editor, King Features Service, and others.

Bridge Souvenir Edition of Newspaper

The dedication of the new reinforced-concrete bridge across the Connecticut River at Springfield, Mass., has been made the occasion for a notable bridge souvenir edition of the Springfield *Republican*, dated Sunday, July 30. A number of supplements are devoted wholly or in part to the bridge, other notable bridges on the Connecticut and elsewhere, navigation on the river, and various historical and biographical articles relating to Springfield and the Connecticut valley. Numerous illustrations of the Hampden County Memorial Bridge, as the new structure at Springfield is officially named, and of other bridges and structures, as well as of the engineers and contractors, bridge commissioners, etc., add interest and value to the memorial bridge number. The front page of one of the supplements is devoted to poems suited to the occasion, written in a competition for prizes offered by the *Republican*. A feature of the souvenir number is a reprint of the sermon delivered in 1805 at the dedication of the old toll bridge which the new concrete bridge supersedes. The engineers for the new bridge were Fay, Spofford & Thorndike and the contractor was H. P. Converse & Co., all of Boston.

Data on Winds High Above Ground

A vast mass of data of atmospheric observation from kites is brought together in "Aerological Survey of the United States," part 1, just issued by the United States Weather Bureau. Like many other products of that office it contains some engineering data in its large amount of material, but these few data are not collated or digested in such a way that the engineer can make direct use of them. The observations recorded were made at eight points, from Broken Arrow, Okla., to Blue Hill, Mass. They cover temperature, humidity, barometric pressure, wind direction and velocity, etc., at elevations ranging up about three miles above sea level.

The wind data are important to the engineer, who has lately come to be concerned in the increase of wind pressure at some height above the surface. These data are brought together in a few diagrams expressing the variation of velocity and direction with height, at six stations (Fig. 17), and in two tables grouped on the last page of the publication (Tables 20 and 21), giving the average percentage frequency of wind velocities exceeding 10 meters per second and 20 meters per second, and maximum free-air wind velocities. Considering the great variability of wind phenomena, the information afforded by these diagrams and tables can hardly be regarded as complete, but it does form an important contribution to knowledge on the question of wind pressure variations. The tables indicate that in ordinary winds the pressure at ground level is considerably lower than that at some height, there being a maximum, apparently, between ½ and 1½ miles above ground. The most important question for engineers, whether the extreme velocities at upper levels are greater than the extreme velocities at the ground, is left unsettled.

Veteran Editor Retires

After 20 years of labor as editor of the widely known reinforced concrete journal, *Beton und Eisen*, which he founded, Dr. F. von Emperger has retired from active leadership of the paper with the issue of June 16. His work will be taken up by Dr. A. Kleinlogel, who will, however, continue to have the consulting assistance of his predecessor. With this change the eidtorial offices will be transferred from Vienna to Darmstadt; the business management remains in the hands of the original publishers, Wilhelm Ernst & Sohn, Berlin.

New Japanese Society Publications

The National Research Council of Japan (care of Department of Education, Tokio, Japan) has begun the publication of *Proceedings* and of a *Japanese Journal of Astronomy and Geophysics*. The latter includes Transactions and abstracts, the abstracts being devoted to papers published in Japan.

Italian Engineering Association Journal

Under the title *Ingegneria* the Associazione Nationale Ingegneri Italiani has started a journal. It is published at Milan, Italy, with Ulrico Hoepli as editor. The American agent is G. E. Stechert & Co., 151 West 25th St., New York City.

PUBLICATIONS RECEIVED

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS: Proceedings, 1922—Saint Petersburg, Fla.: C. C. Brown, Secretary. Cloth; 6 x 9 in.; pp. 648; illustrated.

ARKANSAS RIVER FLOOD OF JUNE 3-5, 1921—By Robert Follansbee and Edward E. Jones. Water-Supply Paper 487. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 44; 1 folding map, 1 diagram, and 8 half tones. No free copies left. 10c from Superintendent of Documents, Washington, D. C.

CAST-IRON PIPE—Fourteen Census of the United States, Manufactures: 1919. Prepared under the Supervision of Eugene F. Hartley, Chief Statistician for Manufactures. Washington, D. C.: Bureau of the Census. Paper: 9 x 12 in.; pp. 8.

CHINESE GOVERNMENT RAILWAYS: Statistics for 1920—Peking: Ministry of Communications. Paper; 10 x 13 in.; pp. 50; diagrams and folding map.

COAL—Fourteenth Census of the United States, Mines and Quarries: 1919. By Frank J. Katz, Expert Special Agent for Mines and Quarries. Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 53; 1 map and 2 diagrams in text.

COMPRESSED-AIR ILLNESS AND ITS ENGINEERING IMPORTANCE: With a Report of Cases at the East River Tunnels—By Edward Levy. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 48; one copy free; 10c from Superintendent of Documents, Washington, D. C.

CURRENT METERS FOR USE IN RIVER GAGING—By M. A. Hogan, Ph. D., D.I.C. Prepared for the Committee on Gauging Rivers and Tidal Currents, Department of Scientific and Industrial Research. London: H. M. Stationery Office. Paper; 6 x 10 in.; pp. 33; 7 figures in the text and 3 halftones on plates. Postpaid, 1s. 7½d. net.

Prepared under the direction of a committee that includes in its membership Sir Maurice Fitzmaurice and Prof. W. C. Unwin, the author being technical officer to the committee. Summarizes "information available" on "design and use of current meters" and describes "types now in use." Both the text and the selected bibliography (48 entries) contain numerous references to American practice and literature.

DER KREISTRÄGER—By Georg Unold, Chemnitz. Berlin: Vereines Ingenieure. Paper; 8 x 11 in.; pp. 79.

DIE STATIK DES KRANBAUES: Mit Berüchsaichtigung der Verwandten Gebiete Eisenhoch-Forder-und Bruckenbau—Von W. Ludwig Andrée. Dritte Auflage. Munich und Berlin: R. Oldenbourg. Paper; 7 x 10 in.; pp. 370; 554 illustrations. 348 marks in paper; 390 in cloth.

Considerably enlarged from first edition which was noted in *Engineering News*, Jan. 14, 1909, p. 4 of Engineering Literature Supplement.

DURABILITY OF CEMENT DRAIN TILE AND CONCRETE IN SOILS: THIRD PROGRESS REPORT (1919-20)—By G. M. Williams, Associate Engineer, Bureau of Standards, in Co-operation with R. J. Wig, Consulting Engineer; S. H. McCrory, Chief of Drainage Investigations, Department of Agriculture; E. C. Bebb, Engineer, U. S. Reclamation Service; L. R. Ferguson, Consulting Engineer; C. J. MacKenzie, Engineering Institute of Canada; D. A. Abrams, Engineer, Portland Cement Association; G. E. Warren, Manager, American Concrete Pipe Association. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 29; illustrated. 10c from Superintendent of Documents.

Results of inspection in 1919 and 1920 of experimental drain tile and concrete block installations in eight alkali-bearing projects in the West.

FIRE TESTS OF BUILDING COLUMNS—Boston, Mass.: Inspection Department of the Associated Factory Mutual Fire Companies. Paper; 5 x 7 in.; pp. 109; illustrated.

A digest, with interpretative comment, of 106 tests made in 1917-19 by the company named above, the National Board of Fire Underwriters, and the Bureau of Standards. Two illustrated articles summarizing the tests, written by R. E. Wilson, engineer of the company named in the above heading, appeared in *Engineering News-Record*, July 21 and 28, 1921, pp. 106 and 145.

FORMS, RECORDS AND REPORTS IN PERSONNEL ADMINISTRATION—Edited by C. N. Hitchcock. Chicago, Ill.: University of Chicago Press. Paper; 6 x 9 in.; pp. 128. Postpaid, $1.79.

HIGHWAY ENGINEERING AND HIGHWAY TRANSPORT—Proceedings of a Regional Conference Held at the Agricultural and Mechanical College of Texas, in co-operation with the Highway and Highway Transport Education Committee, United States Bureau of Education, Feb. 6 and 7, 1922. Edited by J. C. Nagle, Dean of Engineering. College Station, Tex.; Texas Engineering Experiment Station. Paper; 6 x 9 in.; pp. 72.

HYDRAULICS—By Horace W. King, Professor of Hydraulic Engineering, University of Michigan, and Chester O. Wisler, Associate Professor of Hydraulic Engineering, University of Michigan. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 237; illustrated. $2.75. 13⅗s. net.

HYDRAULICS WITH WORKING TABLES—By E. S. Bellasis, M. Inst. C. E. Third Edition. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 343. $8.

A belated "American Market" offering of this British work, as revised in 1920 (see extended favorable review by Robert E. Horton in these columns for Jan. 20, 1921, and for lengthy review of the first edition, by the late George W. Rafter, see *Engineering News*, Aug. 20, 1903.

IRON ORE: Summary of Information as to the Present and Prospective Iron-Ore Supplies of the World. London: H. M. Stationery Office. Boards; 6 x 10 in. Part 3, British-America, pp. 115. 3s. 9½d. Part 4, British Asia, pp. 65. 2s. 8½d. Part 5, Australia and New Zealand, pp. 106. 4⅛s.

LECTURES ON ENGINEERING PRACTICE, 1921-22—Edited by John B. Whitehead, Dean of the Faculty of Engineering, Baltimore, Md.: John Hopkins Press. Paper; 6 x 9 in.; pp. 148. $1.

Four lectures, "one each in the general subjects of chemical, civil, electrical and mechanical engineering." The one under civil engineering is, "Construction of the Catskill Water Suply for the City of New York, from an Engineering Standpoint," by J. Waldo Smith, chief engineer, Board of Water Supply, New York City.

MATERIALS OF CONSTRUCTION—Prepared for the Extension Division of the University of Wisconsin by H. E. Pulver, B.S., C.E., Associate Professor of Civil and Structural Engineering, The University of Wisconsin. [Engineering Education Series.] New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 318; illustrated. $3.

MECHANIK—By Fritz Rabbow, Dr. Ing., Hannover. Berlin: Julius Springer. Boards; 6 x 10 in.; pp. 203; 237 text figures.

MUNICIPAL SANITARY PRECAUTIONS DURING EPIDEMICS OF INFLUENZA: Rambling Thoughts of a Civil Engineer—By Dr. Willim Paul Gerhard, C.E., Consulting Engineer, 17 W 42nd St., New York City. Reprinted from *Municipal and County Engineering*, April and May, 1922. Published by the Author. Paper; 6 x 9 in.; pp. 8. 30c.

NAVIGATION INTÉRIEURE: CANAUX—Cours Professé à L'École Nationale des Ponts et Chaussées. Par O. Jacquinot, Inspecteur Général des Ponts et Chaussées. [Encyclopédio du Genie Civil et des Travaux Publics] Paris: J. B. Bailliere. Paper; 6 x 9 in.; pp. 600; 244 illustrations. 45 fr. in paper.

Complete exposition of European, mainly French, practice in design and construction of canals and their appurtenances. Well illustrated by drawings of actual structures and installations. Includes studies of dams, locks, gates, etc., as well as the hydraulics of canalization.

NEW BUILDING ESTIMATORS' HANDBOOK, 1922—A Handbook for Architects, Builders, Contractors, Appraisers, Engineers, Superintendents and Draftsmen. By William Arthur, Author of "Estimating Building Costs," "Home Builder's Guide," "Contractors' and Builders' Handbook," etc. New York: U.P.C. Book Company, Inc. Cloth; 5 x 7 in.; pp. 1002; illustrated. $6.

Twelfth edition of a well known and much appreciated handbook first published in 1904 as a volume of 150 pages. Earlier editions were noted in these columns Aug. 18, 1904, April 15, 1909, and June 16, 1910.

PROCEDURE FOR SECURING STATE APPROVAL of Formation of Irrigation Districts, Issuance of Bonds by Irrigation Districts, Expenditure of Construction Funds by Irrigation Districts, Construction of Dams, Before State Department of Public Works, Division of Engineering and Irrigation, and California Bond Certification Commission. Sacramento: State Department of Public Works. Paper; 6 x 9 in.; pp. 14.

PROPOSED NEW WATER SUPPLY FOR HOBART, TASMANIA—Report by Herbert E. Bellamy, M.Am.Soc.C.E., City Engineer of Hobart. Paper; 9 x 13 in.; pp. 20; illustrated.

Recommends gravity supply from Lake Fenton, in National Park, through 54-mile steel pipe line, of which 40 miles would be of 27- and 14 miles would be 24-in. diameter. Total estimated cost, £660,000, including £500,000 for pipe line, £25,000 for balancing reservoirs and £86,100, a 15 per cent allowance, for engineering, etc.

RETAIL PRICES, 1913 to December, 1920—Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 217.

SURFACE WATERS OF KANSAS, 1895-1919—[Prepared by Roger C. Rice, District Engineer, United States Geological Survey, under a co-operative agreement between Kansas Water Commission and the Survey]. Topeka, Kan.: Kansas Water Commission. Paper; 6 x 9 in.; pp. 463.

Gives available stream flow data for period named, mostly as gauge heights, but includes many discharge figures.

THE THEORY OF GENERAL RELATIVITY AND GRAVITATION—Based on a Course of Lectures Delivered at the Conference on Recent Advances in Physics held at the University of Toronto in January, 1921. By Ludwik Silberstein, Ph.D. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 137. $2 net.

Assumes familiarity with "the essentials of Einstein's older or special relativity" or recourse to the author's "Theory of Relativity" (Macmillan, 1914). Special care has been taken in one of the chapters "to give readers a systematic exposition of the calculus of generally covariant beings called Tensors." The author feels that regardless of the fate of "Einstein's admirable theory" the time applied by readers of this book to "the Tensor Calculus and acquiring some skill in handling it will be well spent."

TRADE STANDARDS IN THE PUMP INDUSTRY—Recommended by the Hydraulic Society, 1922. Second Edition. (Prepared by C. H. Rohrbach, Secretary, 50 Church St., New York City.) Paper; 6 x 9 in.; pp. 21.

Additional tables and explanatory data are given in this edition. Contains names and addresses of 28 pump manufacturers composing the Hydraulic Society, located in ten states from Massachusetts to California.

ZONING FOR CITIES AND TOWNS—By Rolland S. Wallis, Municipal Engineer. Ames, Iowa: Engineering Extension Department, Iowa State College. Paper; 6 x 9 in.; pp. 15.

A summary of zoning principles and practice.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Heavy Rainfall in Southern Alberta, Canada

Sir—The following account of what appears to the writer to be a record in concentrated rainfall may be of interest to your readers.

On July 7 a severe storm broke over a limited area in southern Alberta. It covered a strip of country about two miles in width and seven miles long lying five miles west of Nobleford, a small town on a branch of the Canadian Pacific Railway. Rain fell steadily for three hours with some lightning and much hail. A wagon box after the storm was found to have 16 in. of water in it, and a large slough with a surface area of about 1 sq.mi. and a catchment area of about 6 sq.mi., which was dry before the storm, was 3 ft. deep after the storm had passed. During the period of greatest intensity a competent witness estimated that the precipitation was at least 8 in. in 50 minutes, and that in one 20-minute interval at least 3 in. fell.

Surprisingly little damage was done by the storm. Uncompleted works of an irrigation district were damaged by flooding, and some crops were destroyed by the hail. But the damage by erosion appears to be little, owing, no doubt, to the small slope of the country.

H. B. MUCKLESTON,
Chief Engineer,
Lethbridge Northern Irrigation District.

Lethbridge, Alta.

Questioning Abrasion Tests

Sir—In *Engineering News-Record*, March 16, 1922, there is an article under the caption "Abrasion Tests of Aggregates Disagree" which summarizes a series of investigations conducted recently by Prof. D. A. Abrams, of Lewis Institute.

In this article, Professor Abrams is quoted as stating that "It is difficult to draw any conclusions from these tests except to suggest a grave doubt as to whether any of the tests has any significance when applied to aggregates for concrete roads." The writer does not believe that Professor Abrams is warranted in drawing any such conclusions solely on the basis of these abrasion tests. In the first place, the so-called "Rea Method" was not designed for, and is never used for testing crushed stone aggregates. By this method, six cast iron shot are used as an abrasive charge entirely for the purpose of producing wear on the rounded gravel fragments. This method will, of course, give unusually high results when testing crushed stone aggregates, due to the excessive amount of wear on the angular fragments composing the test charge. Conversely, neither the "A.S.T.M. Method" nor the Mattimore modification of this method, were designed, nor are they ever used, for testing gravel. Professor Abrams has applied all of these tests indiscriminately to both types of aggregates and has found that the results disagree. Of course they disagree. One would hardly expect otherwise under the circumstances.

It is quite possible that the abrasion test when applied to concrete aggregates may not have the same significance as when it is used for the purpose of studying the suitability of stone for macadam road work. Experience in Illinois and other states where comparatively soft aggregates abound, would indicate that the percent of wear may be raised considerably above the limit which has previously been considered safe, without seriously affecting the quality of the resulting concrete and the writer believes that the orthodox interpretation of the results of "French Coefficient" tests may be questioned in the light of these service indications. He does not believe, however, that a blanket condemnation of the abrasion test is warranted simply because the results of tests made by various methods, some of which may not be applicable to the material under consideration, disagree.

F. H. JACKSON.
Bureau of Public Roads.

Washington, D. C.
May 26.

Permanent Bridges as a Menace

Sir—In your issue of June 29, pp. 1063 and 1064, you discuss bridge washouts and speak in favor of permanent bridge construction. In considering the relation between floods and bridges, however, the effect of permanent bridges in increasing the destructive possibilities of floods must be kept in mind, and may modify the conclusions you indicated.

Upstream from bridges there are frequently occupied areas, containing business and residential buildings. Water held back by a bridge is likely to flood such a district, causing great destruction. Exceptional floods, like that in the Sandusky Valley in Ohio in 1913, when the water rose more than 9 ft. above any previously recorded high-water mark, may convert a permanent bridge into a temporary dam, increasing the loss of property and of life in the surrounding territory. The loss may far outweigh the value of the bridge, and it may therefore be better to have a bridge go out than to have it withstand the flood.

Concrete bridges are particularly liable to become a menace, on account of their stability. Such bridges are comparatively new creations, while the adjoining territory is old and in many instances has been occupied for a long time under conditions not easily changed or modified.

H. F. DUNHAM,
Consulting Engineer.

New York, July 6.

More Trouble with Metric Compensation

Sir—Referring to the article "How to Figure Grade Compensation for Metric Curves," *Engineering News-Record*, July 27, 1922, p. 141, Mr. Conard is not the only one who has trouble with this problem. Even so great an authority as the late A. M. Wellington became confused in comparing his line, "The American Line from Vera Cruz to the City of Mexico, via Jalapa," (see *Transactions, Am. Soc. C. E.*, Vol. XV, p. 791) with that of the Mexican Ry., and, regarding their respective grades, says: "Continuous 2 per cent (uncompensated) against a broken 4 per cent (uncompensated), including the effect of curvature or of compensation therefor, 2.6 per cent against 6 per cent."

Quoting, with minor changes, from my paper, "A Review of the report of Captain Talcott, chief engineer, Mexico & Pacific R.R.," *Transactions, Am. Soc. C. E.*, Vol. LXXX, p. 1624 (1916), "It is hard to understand what method of computation was used in arriving at the comparative rates of grades, after allowing for compensation. Wellington allowed for his line (3-ft. gage), in which 20 deg. curves occurred, a rate of 0.03 ft. per degree, which would give 0.6 ft. or an equivalent 2.6 per cent grade. For the Mexican Railway (4 ft. 8½ in.) he assumed a rate of 0.11 ft. per degree, which for 18 deg. curves, would give 2.0 ft. or an equivalent 6.0 per cent grade, certainly a most extraordinary method of calculation. With the same rate of curve compensation, the equivalent grade would have been on the Mexican Railway, 4.5 per cent."

It is to be regretted that this misstatement has never been corrected in Wellington's "Railway Location."

EMILE LOW.

Buffalo, N. Y., July 31.

Courses in Fisheries Engineering

The Department of Biology and Public Health of the Massachusetts Institute of Technology announces in a circular just issued that under Industrial Biology it now offers courses in "the relatively new field of fisheries engineering in which we have begun to train specialists."

NEWS OF THE WEEK

New York, August 17, 1922

Flood Control Subject of Texas Conference

Governor Calls Meeting at Which Committees Are Appointed to Formulate Program

Responding to Governor Neff's call, approximately 150 civil engineers from Texas and neighboring states met in conference at Austin, Texas, August 7 to work out a program for conservation of flood waters of Texas and the reclamation of overflow lands that will take into consideration every drainage area within the state. For the past few years much damage has been suffered throughout the state, overflowing rivers last spring destroying approximately $20,000,000 worth of Texas crops.

Before the conference began its business session addresses were made by Dr. Samuel Fortier, U. S. Department of Agriculture; N. C. Grover, chief hydraulic engineer, U. S. Geological Survey; Major B. B. Brown, assistant district U. S. Engineer, Galveston; Col. Glenn S. Smith, acting director, topographic division, U. S. Geological Survey, and Major W. N. Vance, Eighth Corps Area, Fort Sam Houston.

ADVISORY COMMITTEE APPOINTED

On motion of John C. Norris, chairman of the State Board of Water Engineers, Governor Neff appointed an advisory committee consisting of Dean T. U. Taylor, University of Texas, chairman; Major John B. Hawley, Ft. Worth; C. T. Bartlett, San Antonio; E. E. Sands, Houston; Fred A. Jones, J. C. Nagle and E. N. Noyes, Dallas; W. F. Shaw, Mercedes; F. A. Merritt, Galveston; Vernon L. Sullivan, El Paso; E. H. Sellards, Texas Bureau of Economic Geology; R. A. Thompson, Wichita Falls; and W. B. Tuttle, San Antonio.

A resolutions committee, consisting of Major John B. Hawley, Ft. Worth, Alfred Tamm, Harlingen, and E. B. Cushing, of Ranger, submitted a resolution recommending the mobilization of all engineering talent to develop data essential to the effective control of flood and surface waters, for reclamation, irrigation or for other beneficial uses; and urging upon the Texas congressional delegation full use of its power in securing for that state adequate topographic surveys and maps, hydraulic determinations and data of similar character.

The resolution also included a request that the state legislature appropriate adequate funds for weather-bureau work, in collaboration with the U. S. Weather Bureau, and that ample appropriations be made for extending the activities of the State Reclamation Department and the State Board of Water Engineers in securing data upon which to plan and design works for the control and utilization of the flood waters of Texas rivers.

Another conference was scheduled to be held in Waco yesterday.

ENGINEERS IN TWO STATES MOVE FOR REPEAL OF LICENSING LAWS

Repeal of the New York State engineer licensing law is the purpose of a movement that has been started under the auspices of the New York Section of the American Institute of Mining Engineers. A committee of the section has been appointed to raise funds, to cooperate with other engineering societies, and otherwise to forward this object.

A similar movement is under way in Pennsylvania under the endorsement of the Engineering Society of Northeastern Pennsylvania and the Anthracite Section of the American Institute of Mining Engineers. A test case under the licensing law is now in the courts, and in the event that the law is upheld an effort will be made to effect its repeal at the next session of the legislature.

Am. Soc. C. E. Canvasses Second Ballot for Officers

The second ballot to determine the official nominees for offices in the Am. Soc. C. E. was canvassed on Aug. 15 with the following results: For president, Charles F. Loweth, 2,332; Andrew M. Hunt, 701; John F. Coleman, 320; For vice-president, Zone 2; George S. Davison, 478; Richard Khuen, Jr., 257; C. P. Fortney, 64; W. M. Gardner, 31; S. T. Wagner, 26; L. L. Hidinger, 5. For vice-president, Zone 3; Anson Marston, 579; Charles H. Paul, 284. For director, District 3; Glenn D. Holmes, 54; Charles A. Poole, 52; G. G. Honness, 36; Bruce L. Cushing, 27. For director, District 5; E. B. Whitman, 139; H. K. Bishop, 66. For director, District 7; George H. Fenkell, 276. For director, District 8; A. S. Baldwin, 205. For director, District 9; R. N. Begien, 133; J. M. Johnson, 33; Charles H. Paul, 27. For director, District 12; George C. Mason, 124; J. C. Ralston, 95; Eugene Carroll, 20.

Under the constitution, those receiving the highest number of votes for the several offices become the "Official Nominees." The list of these official nominees together with the results of the second ballot are to be mailed to the corporate members of the society not later than Oct. 1. As a result of the death of A. S. Baldwin, candidate of District 8, the selection of a nominee for that district devolves upon the Board of Direction of the Society.

Water-Works Men To Meet

The first of the 1922-23 meetings of the New York Section of the American Water Works Association will be held at Utica, N. Y., Sept. 30. Burt B. Hodgman, 50 Church St., New York City, is secretary of the section.

Effect of Recently-Enacted Pay Bill on Corps of Engineers

Washington Correspondence

According to the best information, in the reduction of the number of officers in the United States Army as provided for in the recently-enacted pay bill, the entire army will be considered as a single list and officers will be eliminated according to the decision of a board of general officers which is now in session. After eliminations have been made it may be found that certain arms of the service have more officers than their quotas and other branches less. It is understood that such inequalities will be adjusted by transfers and temporary details.

Under the Defense Act of June 4, 1920, the Corps of Engineers was authorized to have 602 officers, including a chief of engineers and an assistant chief, and, in addition, a number of officers commissioned in the Corps of Engineers but carried on the General Staff and on the detached officers' list. This additional number ranges from 75 to 100. Under the provisions of the recent pay bill the number of officers in any branch was set at 70 per cent of the number authorized in the Defense Act of 1920. This would give the Corps of Engineers 420 officers, but a provision of the bill allowed an increase or decrease of 30 per cent upon the direction of the President, the total number, however, not to exceed that authorized in the Defense Act. Were the Corps of Engineers allowed the increase, it would then have a personnel of 548, including a chief of engineers and an assistant but not including those holding commissions in the Corps but assigned to duty with the general staff and on the detached officers' list.

The number of officers now commissioned in the Corps is approximately 510. That number is considered insufficient to carry on the duties assigned to the Corps and permit the schooling and training of younger officers. A conservative estimate has been made that 600 officers are needed in the Corps of Engineers to carry on duties assigned to it, to officer fully various engineer units, and to furnish additional officers for the general staff and the detached officers' list. This number would not include the number of officers under training or on river and harbor work.

Laying Track on New Ontario Road

St. John Correspondence

The work of laying the rails on the Temiskaming & Northern Ontario Ry. from Cochrane to James Bay has been started. Grading is about finished, and steel is arriving. The track laying machine arrived recently. Last fall the first sod was turned on this new road, and before winter sets in it is expected that trains will be running as far north as the Abitibi River crossing. This line will open up virgin territory in the north, as far as the coast of James Bay.

I.C.C. Officials Hear Priority Order Dangers to Road Work

Due to the fact that the Interstate Commerce Commission's priority order does not affect open-top cars with sides less than 36 in. in height, and to the fact that there is a surplus of open-top cars in all parts of the country except the states of West Virginia, Virginia, Kentucky, Tennessee and Alabama, which contain the producing coal mines, no great amount of interference with the movement of road-building materials has resulted, except in the states mentioned. The principal danger in the situation, in so far as it concerns the highway program, is that the existing surplus of cars will quickly disappear once that the coal strike is settled. It is regarded as probable that the control of distribution will have to continue until the end of the calendar year and possibly until the end of the coal year on March 30.

In an effort to meet that situation, representatives of the state highway officials and officials of the Bureau of Public Roads have laid all facts of the situation before Interstate Commerce Commission officials.

There has been some interference with the movement of road materials, as a result of the railroad strike, but the reports reaching the Bureau of Public Roads in Washington indicate that, outside of the states comprising the non-union coal district, this has not been serious. It was stated at the Bureau that interference with the transportation of road materials at this time would be particularly bad, since it comes just at the peak of road building activities. It would mean heavy losses to contractors and would make it necessary to carry over into next year most of the projects which were scheduled for completion this year.

Report Made on Trent Valley Water Power

Shortage of water for power in the Trent Valley district of Ontario is due to the operators of the Hydro-Electric Power Commission of Ontario, according to the report just made by Henry Holgate, consulting engineer, of Montreal, to the Dominion Department of Railways and Canals. Mr. Holgate's findings are summarized by the department as follows:

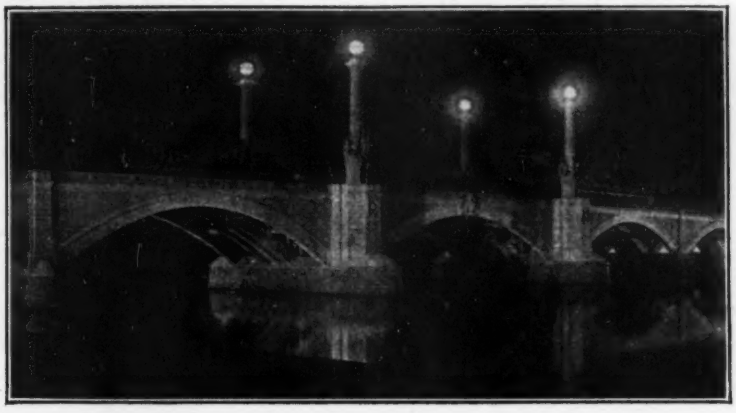
"The cause of complaint was due to the commission's use at their Healey's Falls development of a quantity of water in excess of the inflow to the reach between Hastings and Healey's Falls.

"The demands for power exceeded the capacity of the water supply to produce it, and there was no sufficient foresight shown by the commission in the use of the water—their operators knowing the flow at Nassau and the conditions existing between Nassau and Healey Falls—both as increment and losses due to the absorption and evaporation.

"The officers of the canal have done and are doing everything possible consistent with navigation requirements to facilitate the operations of the commission, but cannot protect the commission against acts of its own operators. The action of the canal officers has plainly been in the interest of the power users and the public generally."

SPRINGFIELD BRIDGE IS OPENED WITH CEREMONY

On Aug. 3 the new Memorial Bridge across the Connecticut River between Springfield and West Springfield, Mass., was dedicated as a part of a two-day celebration which included boat races, an evening pageant, band concerts, community dancing, baseball games and fireworks, as well as a final ceremony participated in by the Governor and a christening by a popular musical comedy actress. The bridge was described in this journal Mar. 30, 1922, p. 514.



Coal Strikes Heading Toward Early Settlement

Following a conference at Cleveland between representatives of the United Mine Workers and operators in five states a break has been made in the bituminous coal strike which has been in force since April 1. Wage scales are now being drawn (Tuesday) on the basis of an agreement reached yesterday between the labor and operating interests that affect an annual output of 60,000,000 tons. Interests representing another 15,000,000 tons, which were originally in the conference withdrew yesterday because of the refusal of the miners to incorporate in the agreement a provision for arbitration of future differences as to wage-scales and working conditions.

It is expected that the agreement will provide for a continuance until next March of the wage-scales in force prior to April 1, and that an advisory fact-finding commission will be established to handle future negotiations. Acceptance of the agreement is open to any bituminous operator. It may be signed by individuals or by organizations, and provides for immediate reopening of mines upon acceptance.

Negotiations looking to a settlement of the anthracite strike will be opened in Philadelphia tomorrow. Prevailing sentiment is optimistic and a speedy agreement is forecast.

Bids Asked for New Aqueduct for Providence, R. I.

Bids for the tunnel portion of the Scituate Aqueduct of the new water supply for Providence, R. I., will be received by the Water Supply Board on Aug. 30. The work consists of about 3½ miles of horseshoe-shaped concrete-lined tunnel with a cross-sectional area equal to a circular tunnel 7⅞ ft. in diameter, except that at and near the portals a 7½-ft. circular section will be used. A construction shaft 140 ft. deep is included. Frank E. Winsor is chief engineer.

Chicago Forest Preserve Will Spend $2,000,000

A bond issue of $2,000,000 placed recently by the Forest Preserve District of Cook County will be used largely in the purchase of land, but will provide also for the construction of roads (concrete and tarred macadam), bridges, sewers and water mains. The construction program has not been completed. Most of the work now in hand consists in building shelter houses and comfort stations in order to provide toilet accommodations for the people visiting the forests. Wells are being put down for water supply, small filter plants built and small isolated chemical sewage plants built. About 22,000 acres have been acquired. Daniel Ryan is president of the District; William J. Gormley, secretary, and E. J. Flavin is the chief engineer.

American Trade Association Executives to Meet

The third annual meeting of the American Trade Association Executives will be held at the Inn, Buck Falls, Pa., Oct. 25, 26 and 27. In view of the discussions that have been going on concerning trade association activities, this meeting is expected to be of particular interest and benefit to everyone in trade association work.

St. John Floods Damage Railroads

St. John Correspondence

Floods on the St. John River have not yet subsided. The Canadian Pacific branch between Woodstock and Hartland in New Brunswick has been greatly damaged by washouts and motor transportation has replaced rail between those points. On the Maine Central continual washouts have delayed service for as much as forty-eight hours at a time and some of the smaller bridges have been threatened by the swollen streams.

A. L. Johnson

A. L. Johnson, president of the Corrugated Bar Co. of Buffalo, who died July 21, was one of the pioneers in reinforced-concrete construction in this country. From 1895, when he became engineer and manager of the St. Louis Expanded Metal Fireproofing Co., until his death he was one of the leaders in the reinforcing steel business, but with his commercial connections he at the same time kept in the closest touch with the scientific development of the field and in his earlier days contributed much to the then limited knowledge of the theory of reinforced concrete.

Mr. Johnson was born at Marlboro, Ohio, Dec. 15, 1865, and when fifteen years old went to St. Louis to live with his older brother, Prof. J. B. Johnson, author of so many well-known text-books and the authority on the subject of materials, who at that time was professor of civil engineering at Washington University. From that school Mr. Johnson graduated in 1887 with the degree of Civil Engineer. During his student days he assisted his brother in government survey work and after graduation immediately became connected with various bridge enterprises, first under Morison & Corthell and later under Robert Moore. These earlier years, too, were spent in water-works design and construction, surveying, and analysis of the federal timber tests made under the direction of Prof. J. B. Johnson.

In August, 1895, he became engineer and manager of the St. Louis Expanded Metal Fireproofing Co. and started the more intimate study of the subject to which he gave the rest of his life. At that time the literature of reinforced concrete in English was most meager, so he set to work to translate into English the various continental texts which were fairly large at that time, and to develop his own theory of reinforced concrete. Much of the literature of the last five years of the last century and the first five years of this was enriched by Mr. Johnson's contributions. Readers will find in 1904, for instance, a long discussion in the columns of *Engineering News* between Julius Kahn, now of the Truscon Steel Co., and Mr. Johnson on the then quite novel subject of shear in concrete. About this time, too, Mr. Johnson developed the deformed bar now made by the Corrugated Bar Co. and known for many years in the trade as the Johnson bar. From 1906 to 1909 he was abroad, organizing various companies for the development of his patented bar, and on his return he became vice-president of the Corrugated Bar Co. manufacturers of reinforcing steel. Later he became its president.

Mr. Johnson became a member of the American Society of Civil Engineers in 1896 and took part in many committee meetings of that society and others. He was a member of the first Joint Committee on Concrete and Reinforced Concrete.

Denver Near Water Shortage

In an open letter to the citizens and water consumers of Denver Colo., dated Aug. 1, the Board of Water Commissioners give warning that the danger point has been reached, for should even one conduit fail to carry its maximum capacity, a serious water shortage would immediately confront the city. The normal carrying capacity of the conduits aggregates 80 m.g.d.; 90 m.g.d. of water was consumed on June 22 and for many days in June the consumption exceeded the carrying capacity. If the water had been available the water-works officials believe the consumption would have risen to 100 m.g.d. Apparently answering the cry for more distribution mains, the letter states that further extensions without additional conduits would spell disaster to the city. While the present pipe system is able to furnish neither adequate supply nor pressure to some sections of the city the large number of new buildings this season brought an increase in the number of customers to an already overburned system. To assuage the critical condition an appeal is made to curtail waste.

The normal annual increase in consumption of a city the size of Denver is 5 m.g.d. Denver's consumption in May and June, 1922, exceeded the rate for these two months in 1921 by 6 m.g.d. Only 47 per cent of the water is filtered; the remainder is made safe by sterilization. Of the water filtered the rate at one of the rapid filter plants is 275 m.g.d. per acre, more than twice the usual 125-m.g.d. rate. In anticipation of the report of the Engineering Board of Review (D. H. Maury, H. T. Cory and H. S. Crocker), which has been at work for several months, the water-works officials state that even larger expenditures will be recommended than were asked for in the bond issue voted on adversely last year. Safety demands, in the opinion of the officials, a total capacity of 150 m.g.d. in conduits and filter plants plus main extensions and reserve capacity in reservoirs and pumping plants.

Contract Let for Part of Buffalo Water Purification Plant

The contract for the substructure of the water filtration plant for Buffalo, N. Y., has been awarded to the Thompson-Starrett Co., New York City, for $1,800,000. George C. Andrews is engineer and George W. Fuller, New York City, consulting engineer for the work.

Garbage Disposal Fund Provided for Section of Philadelphia

An ordinance appropriating $350,000 for municipal street cleaning, destructors, buildings, and machinery has been signed by the mayor of Philadelphia. A destructor plant in the vicinity of Sixth and Romona Streets, to serve the 33d and 42d wards is proposed.

Engineer Reserve Officers Attend Summer Training Camp

Twenty-three engineers were included in the 250 reserve officers of the 2nd Corps Area that attended a two-week training period at Camp Dix from July 18 to Aug. 1. Under the new plans for development of the organized reserve the summer training-camps are designed to impress upon reserve officers the unity of the army and the importance of their place in the scheme of things, as well as to keep them abreast of the developments in the military art during and since the World War.

During the training period, mornings were devoted to terrain exercises in which engineer field officers participated with those of the line, while company officers received special technical instruction. In the afternoon detachments of regular troops illustrated combat manoeuvers, using all arms and equipment. Company A of the 1st Engineers worked out full-scale problems in wiring and demolition.

Reserve officers who attended the camp have expressed high approval of the scope and conduct of the work and indicate a desire to support extension of the training-camp scheme along the lines of current development.

ENGINEER RESERVE OFFICERS AT CAMP DIX

Top row, 1st Lt. V. J. Milkowski, 2nd Lt. S. J. Vastola, 1st Lt. John Arthur, 1st Lt. Ralph Shultz, 1st Lt. R. J. Martin, 2nd Lt. R. P. Liddell, 1st Lt. F. M Thoreburn. Center row, Capt. M. Korn, Capt. S. J. Maddaugh, 1st Lt. F. J. Gallegher, 1st Lt. H. G. Lambert (instructor), Capt. C. H. Crooks, Capt. O. V. Derr, Capt. A. J. Fisk, Capt. F. S. Wells. Bottom row, Capt. A. J. Crom, Maj. G. W. Cobb, Maj. W. A. Smethurst, Lt. Col. L. L. Calvert, Maj. R. E. Guyer (instructor), Capt. W. N. Thomas, Jr. (instructor), Maj. W. R. Tenney, 1st Lt. (Chaplain) J. A. Hammond.

The Engineer in Public Life

JAMES ELMO SMITH

Since 1919 Urbana, Ill., has had an engineer as its mayor. After service in the City Council from 1913 to 1917, James Elmo Smith received both the Republican and the Democratic mayoralty nominations and was elected by a large majority three years ago.

Mr. Smith was born in Sharon, Wis., in 1877 and after graduation from the University of Wisconsin in 1902 with the degree of B.S. in Civil Engineering he entered railroad construction in Tennessee under the late W. D. Taylor. He was successively with the C. B. & Q. R.R., the Wisconsin Central R.R. and the Virginia & Southwestern Ry. as resident engineer or in some similar capacity. In September, 1907, he was employed as instructor in the civil engineering department of the University of Illinois and has been with that institution continuously up to the present. He is a member of the American Society of Civil Engineers, the Society for the Promotion of Engineering Education, the Illinois Society of Engineers, and for several years a member of the American Railway Engineering Association. He is also a member of the executive committee of the Illinois Municipal League.

As mayor of Urbana, Mr. Smith's aim has been to give an efficient administration, and to make Urbana measure up to her opportunities as a great educational center. About $750,000 has been spent on local improvements, the city is well equipped with pavements, lights and parks.

Mayor Smith has also for several years been a member and the secretary of the Urbana Board of Education.

Contractors Propose Excursion to South America

A winter excursion to Panama, Argentine and Brazil to study opportunities for construction work and to learn the conditions under which construction has to be prosecuted is proposed by *The Earth Mover*, of Aurora, Ill. It is planned to start early in December and remain two or three months visiting the principal cities and such construction operations as are accessible along the main routes of travel. It is pointed out that in all South America there is prospect of great activity in railroad, public works and highway construction.

It is believed that a visit by a representative body of American contractors would result in some contracts, as well as establishing acquaintance and confidence leading to future business relations of mutual benefit and profit. Contractors interested in the trip may secure further information by addressing the editor of *The Earth Mover*, Aurora, Ill.

New Kind of Engineering

Dr. Frank A. Waugh, professor of landscape engineering, Massachusetts Agriculture College, has been appointed recreation engineer in U. S. Forest Service. His work will be the development of public camp grounds and summer home sites in the National Forests of the western states. It is part of an established plan toward providing adequate camp and sanitation facilities for the 5,500,000 tourists who visit the national forests yearly.

Program for Port Authorities' Convention Announced

Operation and management of the ports of New York, San Francisco, Chicago, and New Orleans, besides general questions relating to port management, make up the major portion of the discussions to be had at the annual convention of the American Association of Port Authorities which will be held in Toronto, Sept. 14-16 inclusive. Among the speakers will be E. H. Outerbridge, chairman, Port of New York Authority; B. F. Cresson, Jr., chief engineer, Port of New York Authority; Bancroft Hill, J. H. Walsh of New Orleans, John Meigs, John H. McCallum of San Francisco, Joseph B. Strauss of Chicago, and Dr. Herman von Schrenk.

The convention will be opened by an address by C. Alfred Maguire, Mayor of Toronto.

Arbitration Court Plans to Cut Legal Red Tape and Delays

Based upon a little-known law passed by the New York State legislature in 1920, which provides that any persons who wish to arbitrate a dispute may present it to an arbitrator of their own selection, free from the formalities of the ordinary court, the Arbitration Society of America has been organized and has opened headquarters in New York City.

Under this plan, the arbitrator may be any one selected by the parties to the controversy and may be of any vocation. He will have the power of subpoena and of rendering judgment, financial or otherwise, from which there is no appeal except in case of proved fraud and corruption. The society now has pledges of assistance and of service as arbitrators from hundreds of prominent business and professional men who are willing to serve without compensation. All kinds of controversies, except criminal, divorce and a few special actions, may be lawfully determined by these arbitrators. The tribunal will be open to trade disputes, but will not be a trade court, and settlement of industrial controversies will, for the time being, be discouraged. The cost of arbitration will be small and it is expected that these courts will become "poor men's courts."

The society plans to conduct an international campaign of education to promote the general cause of arbitration for all disputes and differences, to move for a uniform arbitration law in all the states, to urge the insertion of arbitration clauses in all trade and industrial contracts, and to organize and operate in New York City and elsewhere, tribunals of arbitration to carry on this work. The executive offices are now at 115 Broadway, New York.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

The Texas Section, American Society of Civil Engineers, will hold its fall meeting in San Antonio, Texas, October 20 and 21.

PERSONAL NOTES

M. B. GREENOUGH, who has been secretary of the National Paving Brick Manufacturers' Association for the past several years, will sever his connection with that organization Jan. 1, 1923. He has been offered, and has accepted, an opportunity to become associated with W. M. Lasley, of the Southern Clay Manufacturing Co., Chattanooga. His new association will be with a firm, not only dealing in paving brick, but doing contracting and other business as well.

C. H. BIRDSEYE, chief topographer of the U. S. Geological Survey, is making an inspection trip through the western states. On September 1 he will join the party being formed by E. C. LaRue for a trip from the Colorado river. During Col. Birdseye's absence, E. M. Douglas will be acting chief topographic engineer.

COL. WM. KELLY, chief engineer of the Federal Power Commission, is in California making a personal inspection of water-power projects.

MAJOR E. A. WOOD, formerly engineer for the metropolitan development association of the Dallas Chamber of Commerce, was appointed city plan engineer for the City of Dallas, Texas, on Aug. 1. Major Wood has been engaged in city planning in Dallas for the past three years under the direction of George E. Kessler. He had practiced engineering in Canada, the Far East, and later in Texas, with the Texas & Pacific R. R. and the state highway department.

E. W. ROSSITER, formerly chief engineer of the Interstate Iron & Steel Co., Calumet River, Chicago, has been appointed engineer of construction for Freyn, Brassert & Co., engineers, Chicago. Prior to Mr. Rossiter's connection with the Interstate company he was with the American Sheet & Tin

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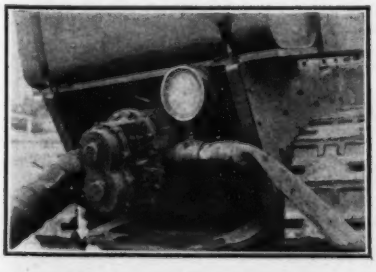

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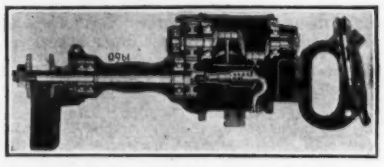

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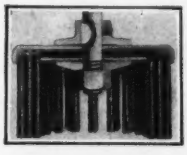

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The makers, the Seydel Chemical Co., Jersey City, N. J., explain the means by which this highly concentrated solution is obtained as follows: The aluminum hydrate is peptized by infinitely small quantities of certain organic compounds that are physiologically harmless. For the precipitation of the hydrate in the floculant state the concentrated coagulant is not dependent upon the hydrogen-ion concentration of the water. The water does not have to be naturally or artificially alkaline to coagulate. This is because the peptizing substances that hold up the hydrate exist in a certain tension that is proportional to the volume of the solution rather than to the aluminum hydrate, which is their substrate. So, although the hydrate bears a definite ratio to its peptizing substances, when the colloidal coagulant is diluted the ratio of the volume of water to the peptizing substances is changed and for certain chemical reasons the peptizing substances no longer hold up the hydrate and it precipitates with subsequent clarification of the solution.

Since the colloidal coagulant is almost neutral in its reaction the natural alkalinity of the water is preserved and the corrosion of pipes due to the hydrogen-ion of carbonic acid is therefore less.

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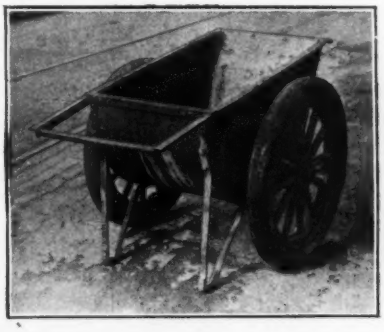

concrete over rough streets, thus avoiding separation of coarse aggregate from the rest of the mix. It also allows the buggies to be handled much more easily.

Out-of-the-Ordinary Trade Publications

Conveyors and Loaders—THE GEORGE HAISS MANUFACTURING CO., INC., New York City, has issued a 24-p. booklet describing its belt conveyors, bag loaders, and wagon loaders. Aside from presenting the usual manufacturers' data concerning mechanical equipment, the booklet is enhanced by comparative costs of loading sand, gravel, and crushed rock by handloading and by the Haiss-loading methods, and by full specifications of each type of machine described. The contractor who is looking for such equipment should have little difficulty in being able to select by reading over this Haiss booklet the particular equipment which will fit his specific needs.

Steel Sash—Full specifications, physical descriptions, details of erection and photographs of many installations of steel sash in various types of buildings make up a 70-p. booklet just issued by DAVID LUPTON'S SONS CO., Philadelphia, Pa. Though most of the material in this booklet is a condensation of previous trade catalogs issued by the company on the installation of Lupton counterbalanced and pivoted sashes, a new feature is a chapter describing the use of steel windows for apartments and residences. This chapter explains the advantages in using steel sash for such construction; and wall and erection details together with standard dimensions for projected windows make the publication a valuable addition to trade literature.

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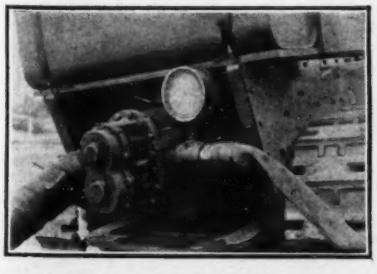

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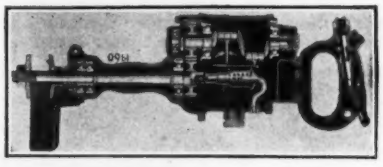

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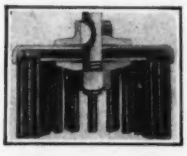

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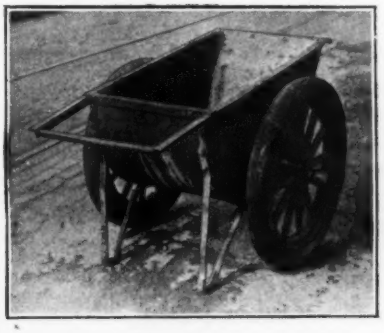


concrete over rough streets, thus avoiding separation of coarse aggregate from the rest of the mix. It also allows the buggies to be handled much more easily.

Out-of-the-Ordinary Trade Publications

Conveyors and Loaders—THE GEORGE HAISS MANUFACTURING CO., INC., New York City, has issued a 24-p. booklet describing its belt conveyors, bag loaders, and wagon loaders. Aside from presenting the usual manufacturers' data concerning mechanical equipment, the booklet is enhanced by comparative costs of loading sand, gravel, and crushed rock by handloading and by the Haiss-loading methods, and by full specifications of each type of machine described. The contractor who is looking for such equipment should have little difficulty in being able to select by reading over this Haiss booklet the particular equipment which will fit his specific needs.

Steel Sash—Full specifications, physical descriptions, details of erection and photographs of many installations of steel sash in various types of buildings make up a 70-p. booklet just issued by DAVID LUPTON'S SONS CO., Philadelphia, Pa. Though most of the material in this booklet is a condensation of previous trade catalogs issued by the company on the installation of Lupton counterbalanced and pivoted sashes, a new feature is a chapter describing the use of steel windows for apartments and residences. This chapter explains the advantages in using steel sash for such construction; and wall and erection details together with standard dimensions for projected windows make the publication a valuable addition to trade literature.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Cement Shipments Heavier Than Production

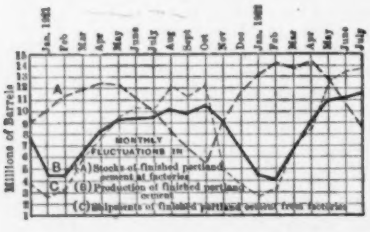
High Fuel Prices and Uncertain Coal Shipments Seriously Affect Industry at Peak of Season

Large cement manufacturers generally agree that uncertain coal shipments and high coal prices, both growing worse, have brought on a serious situation in the industry. In the Lehigh Valley, for example, what coal there is costs $8 per ton at the mines, and the cement companies have only two or three weeks' supply. Some of the plants are running light; others are shut down. The situation is no better in the Middle West. In the Northwest it is reported that there is no coal.

The pressure is increased by the fact that June, July and August are the peak months in the cement industry. Ordinarily shipments then are 12 to 13 per cent of the annual total, as compared with 3 or 4 per cent in the winter and a monthly average of 8⅓ per cent. The Geological Survey shows shipment and production in barrels in the summer months as follows:

1922	Shipment	Production
May	12,749,000	11,176,000
June	13,470,000	11,245,000
July	13,850,000	11,557,000
	40,069,000	33,978,000
Difference	6,091,000 bbl.	

At the same time it is gratifying to note that July stocks, 10,718,000 bbl., were only 432,000 bbl. under those of a year ago. It must be borne in mind, however, that even if the coal strike were settled tomorrow, there would remain the danger of a car shortage.


Millions of Barrels
MONTHLY FLUCTUATIONS IN
(A) Stocks of finished portland cement at factories
(B) Production of finished portland cement
(C) Shipments of finished portland cement from factories

July exports were 96,263 bbl., or 3,805 under June, while the total for the last three months was 271,743 bbl. June imports were 14,179 bbl. as compared with 2,521 in May; July figures are not yet available. Ten barge loads arrived recently from Canada by way of the Welland Canal. Swedish cement is being shipped to a project in North Carolina. The domestic market, however, is handling the great bulk of the demand, as usual.

Price changes at mills have been fewer, owing to the tendency on the part of manufacturers not to book orders for deliveries prior to Nov. 1. Current mill quotations per bbl. in carload lots, without bags, to contractors, with dates of last price changes are shown in the following table:

Buffington, Ind.	$1.80	July 6
Universal, Pa.	1.85	July 6
Steelton, Minn.	1.95	Aug. 1
Fordnick, Va.	2.10	Aug. 1
Mitchell, Ind.	1.95	Apr. 6
La Salle, Ill.	...	...
Iola, Kan.	1.95	Apr. 6
Mason City, Ia.	2.05	Aug. 1
Hudson, N. Y.	2.10	Aug. 1
Leeds, Ala.	1.95	Aug. 1
Hannibal, Mo.	1.95	Aug. 1
Lehigh Valley Dist.	2.00	Aug. 1
Kingsport, Tenn.	1.95	Jan. 5
Richard City, Tenn.	1.95	Jan. 5

In addition to the coal strike, the railroad strike has a direct effect on the cement supply. The equivalent of 377,000 box cars of 50-ton capacity each were required to haul last year's cement output to the consumer, and if the strike ties up transportation it will be impossible to get the cement shipped to the points where it is needed. Incidentally, the textile strike, if it ties up the production of the textile mills, would have a serious effect on the cement industry, as thirty million new cloth sacks are needed every year by the cement mills. These sacks require an immense amount of cloth—a strip 30 inches wide and over 17,000 miles long—and if the mills were unable to supply the cloth for sacks it would be a difficult matter to handle the cement orders.

Bad Order Cars Increase 17,496 in Two Weeks

Car loadings as reported by the American Railway Association for the week ending July 29, totaled 859,733 cars, an increase of 1,391 over the previous week and 64,301 above the total for the corresponding week in 1921.

Coal loadings totaled 76,374 cars, an increase of 314 over the preceding week.

Idle freight cars for the week ending July 23 totaled 387,322, a decrease of 29,707 cars in a week. Of these, 203,322 were freight cars in good repair and in excess of current freight requirements. Bad order cars totaled 184,000 in excess of the normal number unfit for service and idle because of business conditions.

Of 2,258,267 cars on lines, 342,079 were in need of repairs during the week of July 15, as against 324,583 for the week ending July 1, an increase of 17,496.

Wholesale Index Numbers and Commodity Prices

Even if it were not generally known that the price tendency is upward, this list of index numbers, compiled by D. L. Bissell, San Diego, Calif., would clearly establish the fact. Of the ten numbers seven have advanced since June, while dairy products did not change. The rise in farm products was slight, while prices of citrus and deciduous fruits declined from five to seven points since June. In foods, the greatest advance was in provisions; meats rose only one point.

Construction materials stand at 172 in July against 166 in June. It is interesting to note that the *E. N.-R.* Construction Cost Index was 167 in June, 170 in July, and is 173 at present.

INDEX NUMBERS OF WHOLESALE PRICES (COMPILED BY D. L. LISSELL)

1922	Jan.	Feb.	March	April	May	June	July
Farm products	116	123	126	132	128	125	126
Crops	127	131	131	141	134	129	128
Live-stock	100	112	118	116	116	118	122
Orchard products	143	154	162	151	160	170	165
Citrus	77	94	104	100	111	107	100
Deciduous	216	216	217	205	202	215	211
Food	121	125	126	131	132	137	140
Provisions	132	136	143	150	151	157	164
Dairy	128	127	112	113	114	117	117
Meats	99	104	107	111	120	126	127
Textiles and leather	163	166	169	177	182	191	193
Fuel and metals	147	143	144	146	150	153	155
Materials of construction	158	162	166	159	162	166	172
All commodities	134	138	140	144	145	148	151
Raw materials	118	124	126	132	137	137	138
Manufactured products	155	156	158	160	155	160	164

The all-commodities index has risen steadily since January, the total rise being 17 points or 13 per cent.

Average wholesale cash prices of fifty-four commodities, in the principal markets of the country, show twenty-seven advances and 16 declines, with eleven remaining unchanged during July. Prices rose perceptibly in cotton, vegetables, sugar, fresh beef, calfskin leather and bituminous coal and dropped on flour, silk, wool, petroleum and gasoline. Nearly all metals advanced with the exception of lead; cement was the only building material to show an average decline. Dry goods, dairy products, anthracite coal and steel billets remained fairly stable.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 83 to 96, are the following:

A medical school at Cleveland, Ohio, for Western Reserve University, $2,500,000.

A dam at Lake Kenegami for the Provincial Government of Quebec, Canada, $1,800,000.

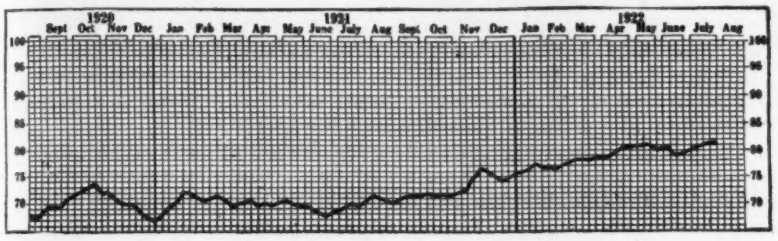
A reinforced-concrete and steel warehouse at Long Island City, N. Y., for J. Butler, Inc., New York City, $1,750,000.

A clubhouse at Milwaukee, Wis., for Milwaukee Elks' Lodge, $1,200,000.

Bond market dull; few offerings, in consequence of smaller demand at this season. See table of representative public bond sales, this issue.

Representative Recent Public Bond Sales

Long term municipal bond sales during July totaled $91,839,171 as against $116,672,630 in June and $104,584,124 for July, 1921, according to records kept by the *Commercial and Financial Chronicle.*



AVERAGE OF 40 LISTED BOND ISSUES—(*The Annalist*)

Among the more important issues were: Philadelphia, $6,000.000 4s at par; Chicago Sanitary Dist., $3,000,000 4s at 97.195, a basis of about 4.36 per cent; Alabama, $2,000,000 4½s at 100.125; Cleveland City School Dist., $3,000,000 4½s at 100.08, a basis of about 4.49 per cent; Essex County, N. J., $2,241,250 4½s at 100.04 a basis of about 4.24 per cent.

Short-term securities issued during July totaled $25,605,000, including $21,150,000 in New York City corporate stock notes.

The trend of forty listed bond issues, published by the *Annalist*, shows the average price at 18.5 points below par during the last week in July as against 30 below for the corresponding period in 1921 and 32 below in August, 1920.

The price movement of bonds other than public is well shown by the *Annalist* curve which averages twenty-five railway bonds, eight industrials, four street railways, two public utilities and one municipal. It will be seen that the rise has been fairly steady since June, 1921. Just at present the curve appears to be flattening, which is to be expected under the conditions created by the two great strikes.

Of the thirty-nine representative issues shown in the accompanying table, five sold at par, thirty-two above and two below par; the yields ranging from 4.13 to 5.80 per cent. The rates varied from 4½ to 6 per cent. All those drawing 6 per cent were in the Southern and Western states excepting one, in Michigan; the 5s and 5½s were mostly located in the Middle West; the 4½s and 4¾s in New England and the Middle Atlantic states and the single 4¼ in Massachusetts.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 83 to 96, are the following large projects:

Forty-eight miles of railroad from Ellinor to Eldorado for Atchison, Topeka & Santa Fe R.R., to Bates and Rogers, Old Colony Bldg., Chicago, Ill., $3,000,000.

A hotel at Syracuse, N. Y., to Amsterdam Building Co., 138 East 44th St., New York City, $2,500,000.

A hotel at St. Paul, Minn., to Smith and Vandanaker, 501 Exchange Bank Building, $1,600,000.

An office building at San Francisco, Cal., to P. A. Palmer, Monadnock Bldg., $1,500,000.

A water filtration plant at Oklahoma City, Okla., to Tibbens and Pleasant, 202 Daniels Bldg., Tulsa, $282,700.

REPRESENTATIVE BOND SALES OF JULY AND AUGUST, 1922

State	Purpose	Amount	Maturity	Rate Per Cent	Basis	Sold For	Dated	Purchased By
Alabama	Road Highway Bridge	$2,000,000	.....	4¼	....	100.125	July, 1, 1922	Barr Bros. & Co. of New York.
County								
Allen, Ind.	Road	72,000	1923-32	4½	4.49	100.034	July 15, 1922	Lincoln National Bank, Fort Wayne, Ind.
Armstrong, Pa.	Road	800,000	1925-42	4½	....	100	Aug. 1, 1922	M. M. Freeman & Co., Philadelphia.
Barry, Mich.	Road	35,000	.....	6	....	102.18	July 22, 1922	Detroit Trust Co. and Stacy & Braun.
Clark, Ind.	Highway improvement	17,000	1923-32	5	4.81	100.91	July 12, 1922	Thos. D. Sheerin & Co., Indianapolis.
Cooper, Mo.	Road	125,000	1924-42	5	....	103.16	Aug. 1, 1922	The Liberty Trust Co. of St. Louis.
Consolidated Irrigation Dist., Fresno, Tulare and Kings Co., Cal.	Ditch	850,000	1924-33	5½	5.28	101.25	July 1, 1922	Bank of Italy and E. H. Rollins & Sons, San Francisco.
Cuyahoga, Ohio	Sewer and water imp'v'ment	91,000	1924-36	5	4.82	101.189	July 1, 1922	
	Road	50,181	1923-31	5	4.85	100.67	July 1, 1922	Guardian Savings & Trust Co. of Cleveland
	Road	18,978	1923-31	5	4.85	100.669	July 1, 1922	
Huron, Mich.	Road	18,000	1932	5½	....	101	July 1, 1922	R. L. Hubbard & Co., Caseville, Mich.
La Porte, Ind.	Road	34,200	1923-32	5	....	100	July 22, 1922	A. P. Andrews, Jr., & Son., La Porte, Ind.
Montgomery, Ohio	Bridge	18,000	.....	5½	....	101.453	July 1, 1922	Otis & Co. of Cincinnati.
Orange, N. Y.	Road	200,000	1932-51	4½	4.13	104.91	Sept. 1, 1922	Barr Bros. & Co., New York.
St. Louis, Minn.	Road	2,000,000	1931	5	4.70	102.07	Jan. 1, 1921	Wm. R. Compton Co. and others.
San Gabriel Co. Water Dist., Cal.	Irrigation	220,000	1926-50	5	....	97.36	.....	Banks, Huntley & Co. and Freeman, Smith and Camp Co.
Shelby, Ind.	Highway improvement	21,160	1923-32	5	4.79	101.02	July 15, 1922	J. F. Wild & Co., State Bank of Indianapolis
Township								
East Pennsboro, Pa.	Road	35,000	1925-40	5	4.54	104.012	July 1, 1922	E. H. Rollins & Sons of Philadelphia.
Municipality								
Andover, Mass.	Highway	100,000	1923-27	4½	4.16	100.95	Aug. 1, 1922	White, Weld & Co.
Belmont, Mass.	City improvements	111,000	1923-37	4¼	4.20	100.691	June 1, 1922	R. M. Grant & Co., Boston.
Bexley, Ohio	City improvement	64,831	1923-31	5½	5.27	101.044	April 1, 1922	Citizens Trust and Savings Bank of Columbus.
Clyde, N. Y.	Street improvement	36,000	1924-35	5	4.75	101.55	Sept. 1, 1922	Geo B. Gibbons & Co., N. Y. C.
		12,000	1924-29	5	4.94	100.25	Aug. 1, 1922	
Condon, Ore.	Water	90,000	1942	6	....	100.50	Aug. 1, 1922	Clark, Kendall & Co. and the Western Bond & Mortgage Co.
Forest City, N. C.	Water	50,000	1925-52	6	5.80	102.15	July 1, 1922	Farmers' Bank & Trust Co. of Forest City.
	Sewer	15,000						
Fredonia, N. Y.	Street improvement	42,000	1923-32	4½	4.625	100.59	Sept. 1, 1922	Barr Bros. of New York.
Granada, Col.	Water	22,000	1937	6	....	97	Aug. 1, 1922	James H. Causey & Co. of Denver.
Hoboken, N. J.	School	1,170,000	1924-62	4¼	....	100	Aug. 15, 1922	Kissel, Kinnicutt & Co., B. J. Van Ingen & Co. and Eldredge & Co.
Hudson, N. Y.	Sewage disposal	12,400	1932	4½	....	100	Aug. 1, 1922	Hudson City Savings Institution.
Lapeer, Mich.	Paving	15,000	1937	5	....	103.91	Aug. 1, 1922	Bolger, Mosser & Willaman of Chicago.
Mead, Col.	Water	16,000	1932-37	6	....	101.07	July 1, 1922	Bankers' Trust Co. of Denver.
Monroe, Mich.	Water	200,000	1936-43	4½	4.54	102.605	July 1, 1922	Benj. Dansard & Co. of Detroit.
	Sewer	100,000	1937-44	4½	4.54	102.605	July 1, 1922	
Mount Kisco, N. Y.	Sewer	32,000	1926-41	4¼	4.43	100.599	Aug. 1, 1922	Farson, Son & Co., New York.
Newport News, Va.	Schools	300,000	1957	5	4.90	101.66	Aug. 1, 1922	Geo. B. Gibbons & Co., New York.
	Streets	150,000	1952	5	4.92	101.33	Aug. 1, 1922	R. M. Grant & Co., New York.
	Equipment	100,000	1932	6	5.66	102.50	Aug. 1, 1922	R. M. Grant & Co., New York.
Orrville, Ohio	Street improvement	47,000	1923-32	5½	5.26	101.14	Aug. 1, 1922	Title Guarantee & Trust Co. of Cincinnati.
Peru, Ind.	Electric light plant	70,000	.....	5	....	101.257	.....	Fletcher-American Co. of Indianapolis.
Saranac Lake, N. Y.	City improvements	65,000	1923-46	4.6	4.58	100.17	Aug. 1, 1922	John B. Thayer of New York.
Sauk Center, Minn.	Waterworks	100,000	1937-52	5	4.64	104.325	July 1, 1922	Lane, Piper & Jaffray, Inc., of St. Paul.
	Storm sewer	2,500	1924-28	...	....	103.12	June 15, 1922	First National Bank of Sauk Center.
	Electric light	10,000	1932	...	....	100.70	July 1, 1922	First National Bank of Sauk Center.
Seneca Falls, N. Y.	Street improvement	43,000	1926-35	4½	4.44	100.565	July 1, 1922	Wm. R. Compton Co. of New York.
	Paving	10,000	1927-36	...	....	.....	.....	
Springfield, Minn.	Waterworks	22,000	1929-34	5	4.97	100.36	July 1, 1922	Kalman, Wood & Co. of Minneapolis.
Tahoka, Tex.	Paving	30,000	.....	6	....	100	.....	Breg, Garrett & Co., Dallas.
Upper Arlington, Ohio.	Street improvement	100,800	1923-31	5½	5.20	101.30	July 1, 1922	Citizens' Trust and Savings Bank of Columbus.

Building Strike in Chicago Not "Settled"

Recent press reports have been so confusing concerning the present status of the building controversy in Chicago that the executive committee of the Citizens' Committee to Enforce the Landis Award has sent out the following statement of the situation:

"The last week in July a committee of international presidents of the building trades came to Chicago, and after investigation made recommendation to the officers of the American Federation of Labor that the Building Trades Council of Chicago be re-organized to include only those unions that are willing to accept the Landis Award. This committee apparently proposes that all 'outlawed' unions that accept the Landis Award be reinstated by the Citizens' Committee and contractors' associations, and thus eventually the entire building industry be turned back to union control.

"The Citizens' Committee welcomes any action on the part of leaders of union labor which will enable workmen in the outlawed trades to return to work in Chicago. However, in justice to the public, whose trustee the committee is, the committee is determined to carry on until permanent fair conditions are established in the building industry and not allow itself to be maneuvered into a settlement which bids fair to be only temporary. The Citizens' Committee has no confidence that the American Federation of Labor or the international presidents could control these outlaw unions should they be restored to power and should these unions again desire to break their contract. Three international presidents last fall came to Chicago to persuade their locals to accept the Landis Award but found themselves powerless as these unions refused to change their position."

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 3; the next, on September 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.83	$3.65	$4.00	+$2.80	$2.95	+$3.70	$3 10	$3.75	$3.75
Structural rivets, 100 lb	3.60	4.35	5.50	+3.35	3.52½	4.80	4.25	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb	2.73	3.50	3.50	+2.70	2.85	+3.67½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	+60%	61.15%	45%	59½%	61.9–5%	46%	+46.6%	+50%	30.00
Cast-iron pipe, 6 in. and over, ton	53.30	+49.00	51.50	45.20	+52.00	57.00	51.00	+53.00	50.00
Concreting Material:									
Cement without bags, bbl	+2.60	2.50	2.25	2.05	2.39	2.85	2.71	2.90	2.78
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	1.80	1.50	1.75	2.25	—1.00	1.50
Sand, cu.yd	1.00	1.15	2.25	1.80	1.00	0.75	1.50	—1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	51.00@52.00	40.00	38.00	47.00	40.00	50.00	31.00	23 00	50.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	11.00	11.15	11.00	17@18	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.0741	.086	.08	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	.0776	.115	.0657	....	.08	.108	.11	+.09
Linseed oil, raw, 5 bbl. lots, gal	.91	.97	1.07	—.97	1.03	1.18	1.04	.86	+1.12
Common Labor:									
Common labor, union, hour	.60	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	+.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.13 cents. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Recent mill rise in price of structural steel, consequent to curtailed production caused by fuel shortage, reflected in higher quotations in Chicago and Denver warehouses. Shapes quoted in Chicago at $2.80 as against $2.68; structural rivets at $3.35 advanced from $3.25, and reinforcing bars at $2.70 as compared with $2.60 per 100 lb., one week ago. Denver quotes $3.70 on shapes as against $3.60 and bars at $3.67½ as compared with $3.57½, last week. Price of steel shapes and reinforcing bars, f.o.b. Pittsburgh, nearing minimum of $1.80 per 100 lb. Quotation of $1.70 fast disappearing, except on orders for shipment during last quarter. Steel pipe discounts reduced 1 point in New York warehouses, 2.5 points in San Francisco and 3 in Seattle, effective Aug. 8. Cast-iron pipe also following general upward trend in iron and steel prices. Advance of 50c. in Seattle, $1 in Atlanta and $1.50 per ton on 6-in. c.-i. pipe, in Minneapolis.

Linseed oil (raw) down 4c. in Chicago but advanced 8c. per gallon (5 bbl. lots) in Montreal.

Common labor rates, in Montreal, quoted at 30c.@35c. as against 25c.@30c. per hr., one week ago. Common labor rate for the whole United States remains at approximately 44c. per hr., with an average of 31c. per hr. for common labor on Federal Aid road projects throughout the country.